HORIZON-CL6-2021-CIRCBIO-01
Innovative solutions to over-packaging and single-use plastics, and related microplastic pollution (IA)

BUDDIE-PACK

Business-driven systemic solutions for sustainable plastic packaging reuse schemes in mass market applications

Starting date of the project: 01/09/2022
Duration: 42 months

= Deliverable: D1.1 =

Review on legislative and socio-economic framework (barriers and opportunities) for reusable packaging

Due date of deliverable: 31/08/2023
Actual submission date: 31/08/2023

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Revision: V1.4

Dissemination level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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DOCUMENT HISTORY

Document version	Date	Change
V1.0	7/06/2023	First draft of the report
V1.1	10/07/2023	Implementation of first comments and delivery of the second draft
V1.2	20/07/2023	Delivery of the third draft
V1.2	24/07/2023	Review by the Coordinator
V1.3	28/07/2023	Delivery of the fourth draft
V1.4	31/08/2023	Final version

DOCUMENT APPROVAL

Reviewers		Validation date
Work Package Leader	Anna SUTHERLAND	31/08/2023
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DOCUMENT DATA

Keywords	reuse, packaging, hygiene, safety, European regulation, standard, good practice
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Delivery date	31/08/2023

HORIZON-CL6-2021-CIRCBIO-01 - GA number : 101059923

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Acronym description

ADEME	Agence de la Transition Ecologique (formerly Agence De l'Environnement et de la Maîtrise de l'Energie)
AGEC	Anti-Gaspillage pour une Economie Circulaire (French Anti-Waste Law for a Circular Economy)
BtoB	Business to Business
BtoC	Business to Consumer
BYO	Bring Your Own
DRS	Deposit Return Schemes
ECHA	European CHemicals Agency
EFSA	European Food Safety Authority
EPR	Extended Producer Responsibility
EU	European Union
FCM	Food-Contact Materials
GA	Grant Agreement
HACCP	Hazard Analysis and Critical Control Point
HORECA	HOtels, REstaurants and CAfés
NGO	Non Governemental Organisations
NIAS	Non Intended Added Substances
OECD	Organisation for Economic Co-operation and Development
PET	Poly Ethylene Terephtalate
PPWR	Packaging and Packaging Waste Regulation
PVC	PolyVinyl Chloride
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RFID	Radio Frequency IDentification
SME	Small and Middle-sized Enterprises
SML	Specific Migration Limit
SSbD	Safe and Sustainable-by-Design
SUP	Single-use Plastic
UK	United Kingdom
WP	Work Package

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Executive Summary

By making a state of the art on the regulations and standards, in force and in progress, this deliverable aims to better inform the regulatory aspects of the design of reusable packaging and to analyse the barriers and opportunities to implement the reuse of packaging, so as to spot potential conflicts with constraints linked to this purpose.

The first part is dedicated to the main definitions useful to understand the subject of packaging reuse.

To make a relevant state of the art in the second part, we investigated two major issues which both concern the reuse of packaging, at European and national levels, in countries of BUDDIE-PACK's partners: hygiene on one hand and packaging on the other hand, in order to identify any pain point in the reuse of packaging. It can be noted that all the hygiene regulations that we have identified relate to the food sector and do not include any mention of non-food products, such as home care products, which are operated in the use case of ASEVI.
Regulation (EC) N°852/2004 lays down the general rules on the hygiene of foodstuffs and especially requires that containers used for transporting foodstuffs to be designed so that adequate cleaning is possible, and to be dedicated for the transport of foodstuffs. Complementary good practices are also mentioned in the Codex Alimentarius, an internationally recognized collection of food standards, and in the ISO 22000 and EN 15593:2008 standards.
In Directive 98/83/EC on the quality of water likely to be used in the food industry, despite microbiological and chemical requirements, a vagueness can be observed on three parameters impacting hygiene, which are the colour of water, its smell and its taste: indeed, the Directive only requires that these parameters must be “acceptable to consumer” and that “no unnatural change” can be observed, which means that non-compliance thresholds may vary according to the stakeholders.
Standard EN 17735:2022 is essential to guarantee the safety of washing, as it specifies the hygiene requirements for the operation of commercial dishwashers in a professional environment and also includes the main guidelines for obtaining hygienic results for treated articles. To close the chapter on hygiene, one must note that a standard exists to assess the efficience of disinfectants in the food area through a quantitative test on a nonporous surface, such as steel, but that such a standard does not exist on plastic surfaces.

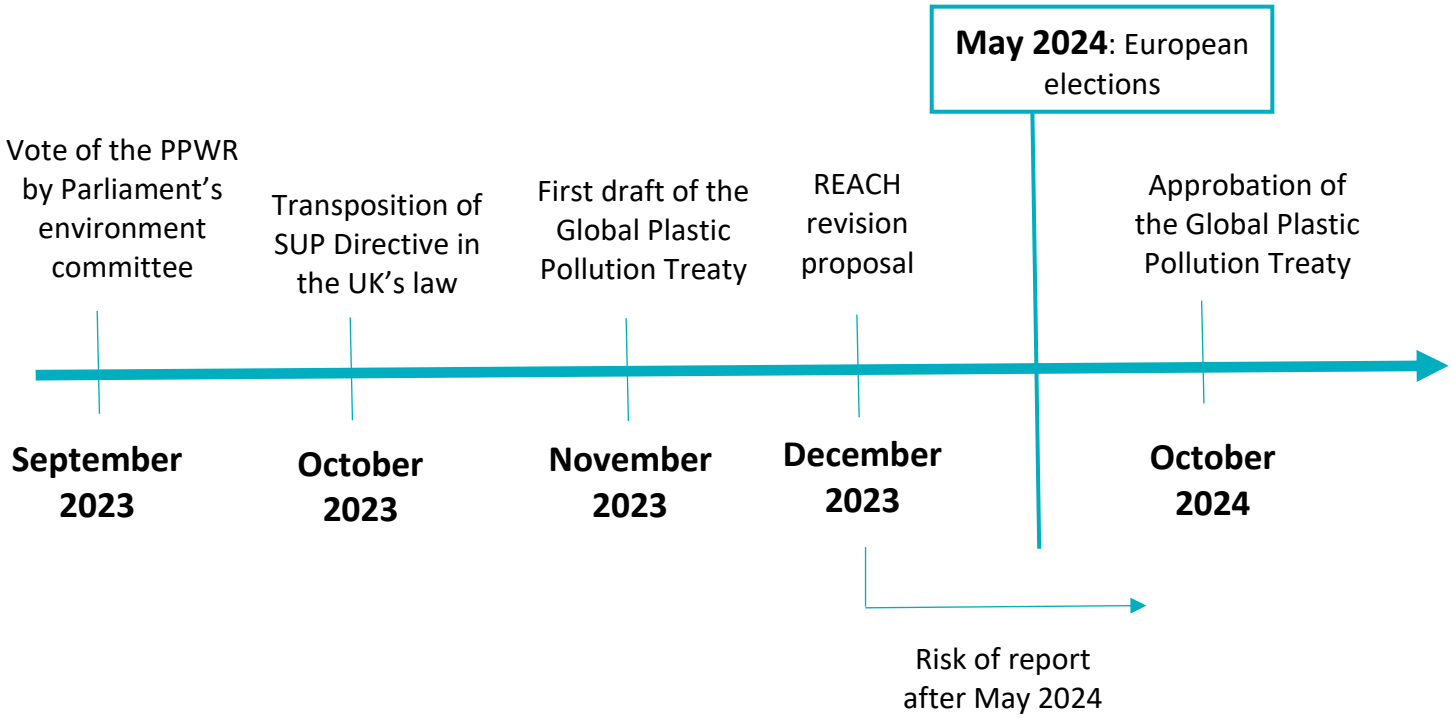
The third part presents the packaging regulations from four angles (design, food contact, production and recycling, non-food products) and an institutional analysis.
Directive 94/62/EC, on Packaging and Packaging Waste (PPW), is currently being revised by the European Commission: it should become a Regulation, directly applicable by all Member States, and shall further support the implementation of reusable packaging. The vote is expected in September 2023. It should be noticed that the restrictions set in Directive (EU) 2019/904 SUP (Single-Use Plastic) only concern single-use plastic packaging.
Regulation (EU) N°10/2011 regulates the safety of plastic materials in contact with food. It gives guidance on specific migration test methods, including for reusable materials: its limitation is that it considers a low number of reuses, so it does not take into account the possible degradation of the material, such as scratches which are inherent in the prolonged reuse of packaging and which can impact the migrations of substances. The REACH Regulation, also under review, establishes procedures for evaluating information on the properties and hazards of chemical substances. Due to the many substances used in the manufacture of plastics and required to make them sustainable, REACH revision may have an impact on the development of reusable packaging.
In Regulation (EU) 2022/1616 setting the operating rules of all recycling stages, it is interesting to remember that recycling schemes, of any material, in a closed and controlled chain may be considered as suitable to recycle waste plastic into food-contact plastic, in the same way as mechanical PET recycling. This principle could be implemented

for any reusable packaging provided that it is used in a closed system and that external non-foodstuffs contaminations are avoided.

Regulation (EC) N°648/2004 on detergents, such as ASEVI's products, does not mention any requirement on the packaging.
Some of BUDDIE-PACK's partners countries, France, Spain, Germany and The Netherlands, have passed laws to implement reusable packaging, with a focus on food or beverage consumption, on-site or on-the-go. While France explicitly banned single-use packaging in several sectors in addition to the on-site catering, Germany and The Netherlands set less restrictive incentives for on-site and take-away catering, and Spain addressed quantified reuse targets for take-away beverage and beverage sold in food retail stores.
Note that the UK's exit from the EU led to the transposition of most of regulations mentioned in this deliverable into national law, without significant differences with European regulations, except the SUP Directive, for which an equivalent legislation is expected in October 2023.
Beyond these regulations already adopted to promote the reuse of packaging, this dynamic is much broader than Europe: thus, the United Nations Environment Assembly has created an Intergovernmental Negotiating Committee responsible for drafting a text "legally binding" by October 2024. The work sessions should result in a first draft text by November 2023.
The suggestions of NGOs converge on the development of shared logistics infrastructures and user-friendly packaging, the expansion of DRS to encourage consumer engagement, but also the standardisation of LCA methods to ensure data reliability. The NGO Zero Waste Europe also insists on the need to implement economic levers to encourage companies to offer reusable packaging, and consumers to choose it.

The fourth part gives more details on the main expected modifications in the regulations being revised, especially the PPW and the REACH Regulations, which could impact the development of reusable packaging.

Figure 1: Chronology of the main regulatory revisions in progress likely to impact plastic packaging



To help provide answers to BUDDIE-PACK use cases, the fifth part summarises the regulations and standards that cover each use case, in order to find all information sources at a glance, to incorporate them into the packaging design and to produce packaging fully adapted to the needs.

To conclude with this deliverable, the sixth part explains the main barriers and above all the opportunities, at regulatory, technical, safety, social and economic levels.
As the hygiene regulations establish an obligation of results towards the actors of the value chain, and not of means, the reuse of packaging does not conflict with hygiene constraints on condition that each part provides the required health guarantees on its scope. Our innovation approach and its proof of concept should allow to identify risky points in advance and to develop solutions to scale up without risk. The debate on the revision of the REACH Regulation will have to be considered into the SSbD concept. In addition, discussions on the PPW Regulation and the Global Plastic Pollution Treaty may open new perspectives of strategies to implement reusable packaging by the end of 2024.
The two major technical obstacles are the lack of knowledge about the ageing of plastics through cycles of use and washing (degradation of polymer chains after heat treatment, repeated sealing or mechanical stress, water abrasion) and logistics (collection of used packaging, storage, transport). The Digital Product Passport should therefore be an effective lever for optimising the return of packaging and its durability. Moreover, the standardisation of packaging, coordinated at a European level in cooperation with EPRs and business operators shall allow an optimisation of transport and storage. Capitalising on the experience of manufacturing and retailing sectors which already reuse their packaging will be decisive, especially on the logistics.
Solving safety obstacles will be also essential to develop the reuse of packaging, i.e. defining compliance criteria on rinsing and drying to ensure there is no residue of detergent or water, and investigating the risks of migration of substances and release of microplastics, from a material which has been used multiple times. On the first point, depending on the sector, industrial means allow to prevent food contamination (ventilation, humidity control, ease to clean premises and equipments, specially trained staff, etc.). Capitalising on the experience of actors already involved is also an important action lever, such as bottlers or school catering.
Social barriers are difficult to solve because they require changing deep-rooted habits, for both packaging's users and consumers. Restaurants may be afraid of wasting time in their daily tasks (additional time to handle, store, wash, wipe, etc.). Some of consumers could be reluctant to use a packaging that they gauge it has already been used (scratch, small stain, discoloration, etc.), even if it is clean and safe, which requires a specific pedagogy. Active consumerism can effectively contribute to the proper functioning of the reuse loop and is very rewarding for the consumer, as we see it with the successful development in Europe of DRS. Giving back an economic value to packaging should also prevent waste from being abandoned.
Even if their exact role is not yet defined, business operators will have to be strongly involved in the management of the reuse loop in opposition to the management of waste, which is dealt by local authorities. This involvement and the initial investment in packaging will impact their business model. To help them, public policies should support adequate eco-modulations and the development of shared logistics. Various incentives should be also addressed to consumers to encourage them to choose reusable packaging. Finally, a sufficiently tight network of washing centers should allow actors to free themselves from the instability of the costs of the energy necessary for transport.

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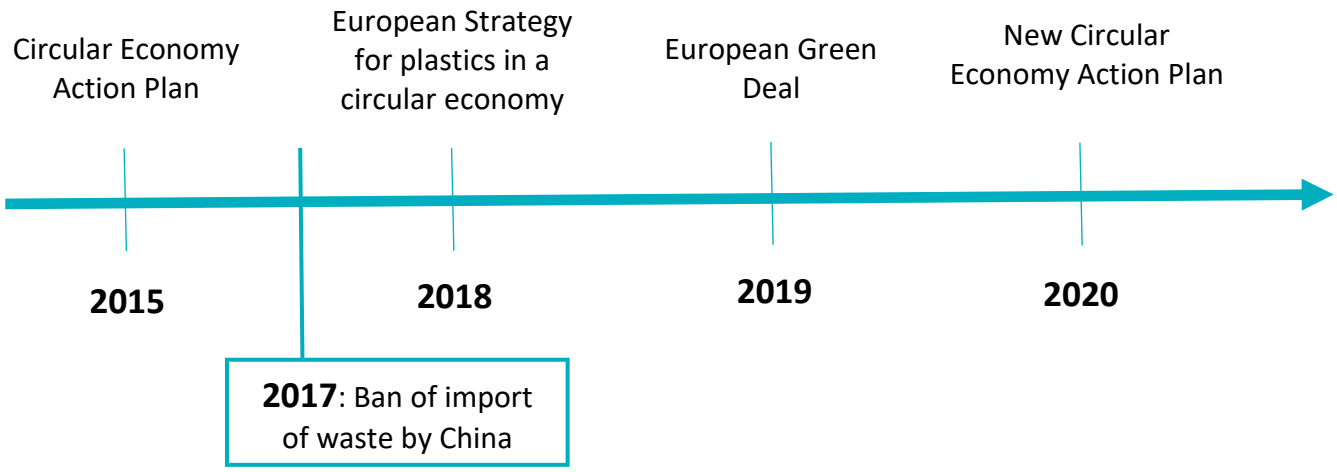
1. Introduction

Incentives to reduce packaging waste - and more particularly plastic waste - has been increasing all over the world for several years. When China decided in 2017 to ban import of waste, and when neighbouring countries took measures in the same direction, western countries became aware of the amount of the waste they generate and began to think about new strategies to manage this waste.

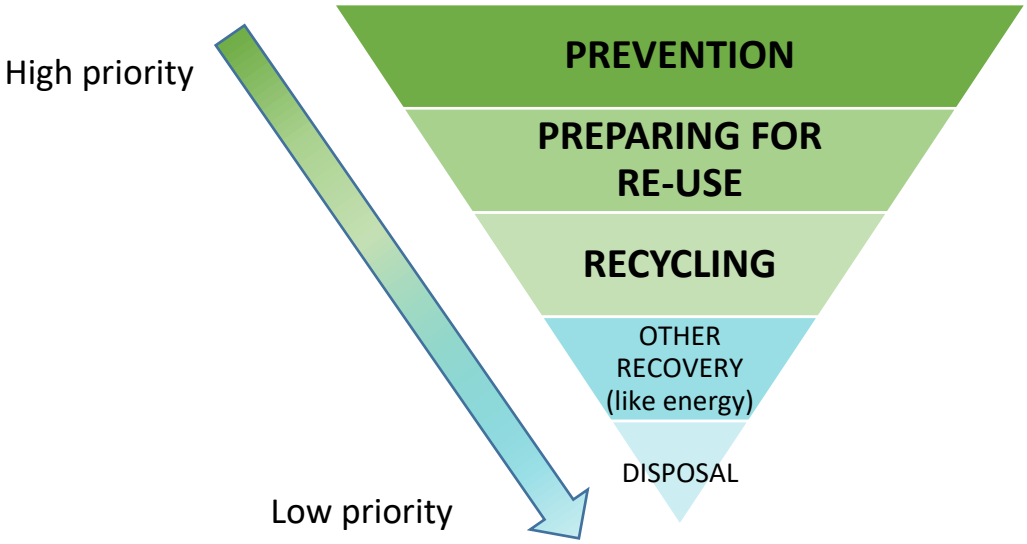
In the EU, after a first Action Plan for a Circular Economy[1] adopted in 2015, the European strategy for plastics in a circular economy[2] completed it in 2018, then the European Green Deal[3] in 2019, and finally a new Action Plan for a Circular Economy[4] in 2020. Gradually, the regulatory framework has changed and measures have become more specific to reduce plastic waste: improving the collection of plastics, standardising the system for selective collection and sorting of waste across the EU in recycling facilities, development of more recyclable plastics, increase in recycled plastic content, restriction of intended use of microplastics in products, rules regarding biodegradable plastics, etc.

Figure 2: Chronology of the main texts regulating the environmental policy in Europe from 2015



Over these years, as debates and technical progress continue in order to better manage the waste issue, it seems increasingly clear that recycling alone will not be enough to turn off the tap on plastic pollution. Alongside the development of recycling solutions, public policies are returning to the fundamental principle of the waste hierarchy, included in the Directive 2008/98/EC[5] on waste: "The following waste hierarchy shall apply as a priority order in waste prevention and management legislation and policy: a) prevention; b) preparing for re-use; (c) recycling; (d) other recovery (like energy); (e) disposal".

Figure 3: Hierarchy of waste established in the Directive 2008/98/EC



After the Directive 2015/720[6], which set up marketing restrictions for plastic carrier bags, the Single-Use Plastics Directive (EU) 2019/904[7] has been the first step of a strong dynamic in the EU to reduce significantly plastic articles and to question consumers on their uses. Following this directive, several countries have taken advantage of this dynamic to set up new national regulations in the favour of reusable packaging. At the same time, citizens have become more and more sensitive to their benefits on the decrease of plastic littering, which in turn impacted their consumer choices and led to the development of marketing and industrial initiatives.

Still, the framework for the deployment of safe, economically, viable and socially accepted reusable packaging is still to be built. This is even truer for plastic packaging, due to the concerns about potential chemical contaminations and related health safety inherent to their nature. To date, there is no harmonized regulation on this complex subject. For this reason, this deliverable will explore the state of the art on the existing hygiene and packaging regulations, in the EU and in countries of some of the consortium's partners, and the ongoing reviews. It will include also a summary dedicated to better inform the regulation aspects of the packaging design, for each BUDDIE-PACK use case. Finally, this work will be concluded by an analysis of the barriers and opportunities to implement the reuse of packaging, in order to identify potential conflicts with constraints related to this goal.

2. Definitions

The reuse of packaging includes many fields that have not yet been explored. This is why it is worth recalling some definitions mentioned in the regulations in force, mainly European. Understanding these issues and challenges requires complementing them with additional insights and proposing our own definitions for BUDDIE-PACK: it will allow this project to progress in line with the objectives set by EU and national authorities.
For each word, the definitions that we propose for BUDDIE-PACK are listed in Section 2.3.

2.1. Definitions related to packaging

2.1.1. Recyclable packaging

The Directive 2008/98/EC on waste defines the recycling as:

*Any recovery operation by which **waste materials are reprocessed** into products, materials or substances **whether for the original or other purposes**. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations*

In France, the private company CITEO is in charge of managing the Extended Producer Responsibility (EPR) for single-use household packaging. Since the Anti-Waste Law for a Circular Economy (AGEC) n°2020-105[8] was voted in 2020, CITEO also became in charge of operating the transition of industrials, retailers and local authorities towards the reuse of packaging.
Considering the difficulty to collect reused packaging in very various contexts (retailers, restaurants, take-away, etc.), CITEO underlines two hypotheses which could improve the recyclability of reusable packaging, required by the law[9]:

- The prospect of potential operational recycling channels, since the development of circular economy is likely to result in the creation of such new ones;
- End-of-life recovery of reusable packaging in an operational recycling channel dedicated to industrial waste, i.e. their recyclability could be guaranteed through the implementation of a collection and sorting certified process, potentially independent from local authorities.

To sum up, in this context, we can consider the following definition that will be used within BUDDIE-PACK:

A recyclable packaging can be reprocessed into another product, whether for the original or other purposes, other than energy recovery, in a managed collection and sorting process, either by local authorities or via a private business-to-business contract

2.1.2. Refill

The refill should be considered as a specific waste prevention measure and is necessary for meeting the re-use targets. For this reason, the revision of the Packaging and Packaging Waste directive shall consider refill as a solution for reusable packaging and include a definition compatible with reuse systems:

'refill' means an operation by which an end user fills its own container, which fulfils the packaging function, with a product or several products offered by the final distributor in the context of a commercial transaction

In the report "Reuse, Rethinking packaging" (2019)[10] from the Ellen MacArthur Foundation, two models of refill are distinguished:

- the refill at home: consumers refill their reusable container at home (e.g. with refills delivered through a subscription service or bought in stores)
- the refill on the go: consumers refill their reusable container away from home (e.g. at an in-store dispensing system)

For BUDDIE-PACK, we will focus on the "on-the-go" model as it fits ASEVI's and SMURFIT KAPPA's joint use case, aiming the development of two packaging for home care products in supermarkets.

2.1.3. Reusable packaging

At European scale, Directive 94/62/EC[11] on packaging and packaging waste proposes the following definition:

'Reuse' shall mean any operation by which packaging, which has been conceived and designed to accomplish within its life cycle ***a minimum number of trips or rotations****, is* ***refilled*** *or* ***used for the same purpose*** *for which it was conceived, with or without the support of auxiliary products present on the market enabling the packaging to be refilled; such reused packaging will become packaging waste when no longer subject to reuse.*

From 2017, after discussions about plastic waste intensified and resulted in the SUP Directive (EU) 2019/904, several European countries implemented their own regulation promoting the reuse of packaging, to reduce packaging waste and plastic littering. We can observe that these definitions used at national levels are relatively close.

- In France, following the AGEC Law which was voted in February 2020, this definition has been included in the Environment Code[12]:

*'**Reused or refilled packaging**': packaging subject to* ***at least a second use****:*
1) ***Either for a use of the same nature*** *as that for which it was designed, and whose reuse is organised by or on behalf of the producer;*
2) ***Either by being filled at the point of sale*** *as part of the bulk sale,* ***or at home*** *if it is a refill device organised by the producer, is deemed to be reused*

It is interesting to note that the French law distinguishes two types of reuse, both listed in the Environment Code:

*'**Repurpose**': any operation by which substances, materials or products* ***that have become waste*** *are* ***used again***
*'**Reuse**': any operation by which substances, materials or products* ***which are not waste*** *are reused for* ***the same purpose*** *as that for which they were designed.*
Reused packaging must be recyclable*.*

This distinction emphasizes the status of the packaging after its first use (waste or non-waste), the nature and the conditions of its reuse. A packaging can be reused in its whole integrity but for a purpose different from that for which it was conceived: for example, a yoghurt jar in which we put a candle is technically considered as « repurposed », not « reused ».

In France, the Ademe (Agency of the Ecological Transition) is responsible to monitor the national strategy of development of the reusable packaging and reports regularly its progression. Its report "Counting the reuse of packaging in France" [13], published in February 2023, details a method of counting reused packaging and proposes the following rationale regarding the bag-in-box, which is one of our business cases in BUDDIE-PACK (Smurfit Kappa's).

A packaging can contain reusable components and single-use ones. However, it is considered reusable, provided that two conditions are respected:

- Single-use components accomplish a function of closing a primary packaging, labelling or reinforcement to protect the product (barrier property, integrity of the product, health protection…);
- For primary packaging in restauration, the weight of these components is less than 20% of the total weight of the packaging (reusable components + single-use components). For industrial and commercial packaging, this limit is 40%, not 20%.

Based on this definition, the Ademe cites as an example the bag-in-box, able to be used in stores for sales of liquid bulk: if the cardboard box is reused and if single-use components (ex: the plastic pouch) weigh less than 40% of the total packaging, they propose to consider that this bag-in-box is a reusable packaging.
It may be useful to keep it in mind and to rely on it to carry out the project.

- In Spain, the Royal decree 1055/2022 on packaging and packaging waste[14] was recently voted in December 2022 and gives the following definition:

*Reusable packaging: all packaging that has been conceived, designed and marketed to perform **multiple circuits or rotations** throughout its life cycle, being **filled** or **reused for the same purpose** for which it was conceived*

- In Germany, the Packaging Act VerpackG (Verpackungsgesetz)[15] was updated in September 2021 and proposes the following definition:

*Reusable packaging: packaging that is designed and intended **to be reused several times** for the **same purpose**, and whose effective **restitution and reuse are facilitated by adequate logistics** and by **appropriate incentive systems**, usually a deposit*

- This is essential to note that the European Commission is currently revising the Packaging and Packaging Waste Directive 94/62/EC, which is likely to be turned into a Regulation. Based on the draft published in November 2022, the PPWR may include incentives to reuse packaging (e.g. a ban on the free distribution of single-use items or a mandatory implementation of financial mechanisms to encourage customers to deposit reusable packaging).

Even if the notion of « same purpose » is always included in these definitions, it remains rather vague. Beyond the purpose of reuse, it is useful to emphasize the importance of the conditions of this reuse: indeed, it covers many parameters that have influence on the packaging's integrity and can challenge its reuse (nature of content, temperature…).
In addition, the European strategy for plastics recalls that the European Commission "would focus on plastics production and use and work towards the goal of ensuring that all plastic packaging is recyclable by 2030".

To sum up, this information do not contradict Directive 94/62/EC and provide few interesting precisions, which can lead to this final proposition that will be used within BUDDIE-PACK:

A reusable packaging has been conceived and designed:
- to be refilled or reused in the same conditions that it was conceived to accept;
- to accomplish within its life cycle a minimum number of rotations;
- to be restituted and reused with the technical and logistical support of the business operator (collection, infrastructure, incentive system…);
- to be recyclable.

2.2. Definitions related to washing

It does not exist any specific regulation on washing and decontamination, but essential definitions can be found in several European regulations or directive related to these matters, including the three following definitions: biocides, detergents and surfactants, and water intended for human consumption.

2.2.1. Biocide

The Regulation (EU) N°528/2012[16] stipulates obligations on marketing and use of biocides. It defines a biocidal product:

A biocidal product is a mixture of one or more active substances, intended to destroy, repel or render harmless harmful organisms, to prevent their action or to combat them by an action other than physical or mechanical.

Biocidal products include four categories of chemicals: disinfectants, protection products which aim to prevent microbial growth, pest control products and other biocidal products (very specific uses).
Disinfectants include a subcategory specific to surfaces in contact with food, which meet the requirements for the reuse of packaging, especially in the food industry. However, they can pose health and environmental risks due to their intrinsic properties. Even if it is not defined in the regulation, we can propose the following definition:

A disinfectant is a product intended to eliminate micro-organisms that are harmful to human or animal health or causing damage to materials, and therefore to obtain microbiological safety.

2.2.2. Detergent and surfactant

The Regulation (EC) N°648/2004[17] establishes rules to market detergents and surfactants, ensuring a high degree of protection of the environment and human health.
Washing and cleaning processes means elimination of grease, dirt and some micro-organisms. A detergent can be defined as follows:

A detergent is a substance or preparation containing soaps and/or other surfactants intended for washing and cleaning processes.

The properties of surfactants enable to disperse dirt, detergents and disinfectants from surfaces, to entrain them in water and therefore to obtain effective rinsing and chemical safety. A surfactant can be defined as follows:

A surfactant is an organic substance or preparation used in detergents, which has surface-active properties and which reduces the surface tension of water.

2.2.3. Water intended for human consumption

As the reuse of food packaging requires washing, therefore potable water to avoid any health risk, the Directive 98/83/EC[18] can contain useful information to understand the issue. It aims to ensure that water intended for human consumption is wholesome and clean, including for use in the food industry.
According to it, 'water intended for human consumption' shall mean:

(a) all water either in its original state or after treatment, intended for drinking, cooking, food preparation or other domestic purposes, regardless of its origin and whether it is supplied from a distribution network, from a tanker, or in bottles or containers;

*(b) **all water used in any food-production** undertaking for the manufacture, **processing**, preservation or marketing of products or substances intended for human consumption unless the competent national authorities are satisfied that the quality of the water cannot affect the wholesomeness of the foodstuff in its finished form.*

This latter is the more adapted to reuse schemes in industrial contexts.
For the purposes of the minimum requirements of this directive, water intended for human consumption shall be wholesome and clean if it:

- is free from any micro-organisms and parasites and from any substances which, in numbers or concentrations, constitute a potential danger to human health, and
- meets the minimum requirements set out in Annex I, Parts A and B, which gather microbiological and chemical parameters.

2.3. Other definitions

2.3.1. Consumer and user

To conclude with the technical definitions above, it is useful to recall that according to the D1.2 in BUDDIE-PACK, we define the 'consumer' as the citizen-individual who often consumes the product, be that in the home, at a restaurant or canteen or on-the-go.
We also use the term 'user' in order to acknowledge wider actors/individuals across the supply-chain, due to the importance of their role in maintaining engagement with reuse of packaging.

2.3.2. Closed and open loop

The principle of closed or open loop can apply in the matter of waste recycling and in the management of reusable packaging too. We can define it for waste recycling in the following way:

A closed loop for recycling is a management loop of waste, which enables to recycle a given packaging to produce again an equivalent packaging for the same use.

For instance, recycled PET bottles correspond to closed loop recycling, while recycled PET for textiles would be an open loop recycling, as it will be defined below:

An open loop for recycling is a management loop of waste where a given material is recycled to produce new objects that are not necessarily the same as its initial use.

For the reuse of packaging, the definitions would rather be:

A closed loop for reuse is a management loop of packaging, which requires only the involvement of industrial or retailer users, without contribution of the consumer.

A BtoB reuse scheme is assimilated to a closed loop: provided that adequate procedures are implemented and controlled by all the actors who intervene throughout the value chain, it guarantees that recommended use conditions by the manufacturer are respected, to control the quality of collected packaging and to maintain a high-quality reuse. In particular, it can be especially interesting for maintaining the food-contact quality of a packaging.

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An open loop for reuse is a management loop of packaging, which requires the involvement of the consumer, in addition to that of the user(s) (manufacturer, retailer, etc.).

A BtoC scheme is assimilated to an open loop: it enables to extend the collection of packaging until the consumer and to increase the amount of packaging potentially reusable. It requires the increased sorting of packaging, in order to prevent degraded ones from being incorporated and lowering the general quality of reused packaging.

2.4. Summary of definitions applicable for BUDDIE-PACK project

Biocide:
mixture of one or more active substances, intended to destroy, repel or render harmless harmful organisms, to prevent their action or to combat them by an action other than physical or mechanical.

Consumer:
citizen-individual who often consumes the content and is the end-user of the packaging, be that in the home, at a restaurant or canteen or on-the-go.

Closed loop:
1. For recycling: management loop of waste which enables to recycle a given packaging to produce again an equivalent packaging for the same use.
2. For reuse: management loop of packaging which requires only the involvement of industrial or retailer users, without contribution of the consumer.

Detergent:
substance or preparation containing soaps and/or other surfactants intended for washing and cleaning processes.

Disinfectant:
product intended to eliminate micro-organisms that are harmful to human or animal health or causing damage to materials, and therefore to obtain microbiological safety.

Open loop:
1. For recycling: management loop of waste where a given material is recycled to produce new objects that are not necessarily the same as its initial use.
2. For reuse: management loop of packaging which requires the involvement of the consumer, in addition to that of the user(s) (manufacturer, retailer, etc.).

Recyclable packaging:
packaging which can be reprocessed into another product, whether for the original or other purposes, in a managed collection and sorting process, either by local authorities or via a private business-to-business contract.

Refill:
operation by which an end user fills its own container, which fulfils the packaging function, with a product or several products offered by the final distributor in the context of a commercial transaction.

Reusable packaging:
packaging which has been conceived and designed to be refilled or reused in the same conditions that it was conceived to accept;
- to accomplish within its life cycle a minimum number of rotations;

- to be restituted and reused with the technical and logistical support of the business operator (collection, infrastructure, incentive system…);
- to be recyclable.

Surfactant:
organic substance or preparation used in detergents, which has surface-active properties and which reduces the surface tension of water.

User:
any actor across the supply-chain of reusable packaging (industrial actor, conditioner, retailer, washer, etc.). This definition does not include the consumer, which has a special status.

Water intended for human consumption:
For reuse: all water used in any food-production undertaking for the manufacture, processing, preservation or marketing of products or substances intended for human consumption unless the competent national authorities are satisfied that the quality of the water cannot affect the wholesomeness of the foodstuff in its finished form.

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3. State of the art of the hygiene regulatory framework, the good practice and the standards in Europe in the food industry

Reusable packaging requires a washing, which raises many questions about their safety. It covers two levels: the washing hygiene (procedures of decontamination, suitability of facilities and premises, microbiological control, etc.) and the safety related to contact between a product and a plastic material, having already been used several times and likely to adsorb or release substances during its multiple uses (detergents, food, components of the material, etc.). As they may have effects on health, it has to be included in the risk assessment.
In this section, regulations, good practice and standards will be summarised on the issue of hygiene, in order to identify any pain point with the reuse of packaging. It can be noticed that all the hygiene regulations that we have identified relate to the food sector and include no mention to non-food products, such as home care products, which are operated in the use case of ASEVI.

3.1. Hygiene regulatory framework

3.1.1. Hygiene Package

In the EU, a "Hygiene Package" of five regulations rules food hygiene mastery. The first two are general and are applicable to all food business operators, the three other concern only some food sectors or specific activities.

Regulation (EC) N°178/2002 (**the so-called Food Law**)[19] lays down the general principles and requirements of food law, and establishes the EFSA (European Food Safety Authority) and procedures in matter of food safety and specific obligations, such as traceability, withdrawal of products likely to present a risk to public health, information to control services…

Regulation (EC) N°852/2004[20] lays down general rules for food business operators on the hygiene of foodstuffs, at all stages of production, processing and distribution. It takes into account several principles, such as the general implementation of procedures based on the HACCP principles (Hazard Analysis and Critical Control Point). Another given principle is the application of good hygiene practice:

- To keep clean and, where necessary after cleaning, to disinfect, in an appropriate manner, facilities, equipment, containers, crates and vehicles. The need of cleaning is determined by the conditions of use (pasteurisation, etc.) and has to be based on the HACCP plan of each industry;
- To use clean water, as defined previously, whenever necessary to prevent contamination;
- As far as possible, to prevent animals and pests from causing contamination;
- To use plant protection products and biocides correctly as required by the relevant legislation;
- To avoid storing of cleaning agents and disinfectants in areas where food is handled;
- To design conveyances and containers used for transporting foodstuffs so that adequate cleaning and/or disinfection is possible, and to dedicate them for the transport of foodstuffs.

If necessary and depending on the type of sector, the packaging's user can rely on three other more specific regulations:

- Regulation (EC) N°853/2004[21] lays down specific hygiene rules for food of animal origin and is applicable to all food business operators handling or processing animal food or of animal origin;
- Regulation (EC) N°183/2005[22] lays down requirements for petfood hygiene;
- Regulation (UE) 2017/625[23] lays down rules for the performance of official controls and other official activities by the competent authorities of the Member States.

3.1.2. Regulations related to washing

Several regulations relate more especially to washing procedures.

Directive 98/83/EC on the quality of water intended for human consumption, aims to ensure it is wholesome and clean. As precised in the directive, these requirements include also water used in the food industry. Even if the reuse of packaging is not explicitly mentioned, it seems relevant to apply them to the water used for the washing, in order to remove any health risk. To comply with it, the water has to:

- be free from any micro-organisms and parasites and from any substances which, in numbers or concentrations, constitute a potential danger to human health, and;
- meet the minimum requirements set out in Annex I, Parts A and B of Directive 98/83/EC. They detail microbiological requirements on two types of bacteria, and chemical ones on several substances such as metals, pesticides, etc.

With regard to the parameters set out in Annex I, Part C, their values need be fixed only for monitoring purposes. They are recommendations for the concentration of some substances or other technical characteristics, such as conductivity of water. We can notice vagueness on three parameters impacting the hygiene, which are the colour of water, its smell and its taste: about them, the Annex do not give values and only mentions that these parameters must be “acceptable to consumer” and that “no unnatural change” must be observed, which means that non-compliance thresholds may vary between stakeholders.
In the event of non-compliance with parametric values of the Part C, Member States shall consider whether that non-compliance poses any risk to human health, and shall take remedial action where that is necessary.

Regulation (EC) N°648/2004 harmonises the following rules for the placing on the market of detergents and of surfactants for detergents:

- the biodegradability of surfactants in detergents;
- the restrictions or bans on surfactants on grounds of biodegradability;
- the labelling of detergents;
- the information that manufacturers must hold at the disposal of the authorities.

A proposal of repeal was published in April 2023: it aims to take account of new market developments, such as innovative products and sustainable new practices, to incorporate efficient information requirements for detergents and to improve the consistency with other European regulations.

Regulation (EU) N°528/2012 concerns the marketing and use of biocides: it stipulates that treated articles should not be placed on the market unless all active substances contained in the biocidal products with which they were treated are approved in accordance with this Regulation, after submitting an application for approval to the ECHA (European CHemicals Agency).

A biocidal product shall be eligible for a simplified authorisation procedure if:

- all the active substances contained in the biocidal product appear in Annex I of the Regulation and satisfy any restriction specified in that Annex;
- the biocidal product does not contain any substance of concern;
- the biocidal product does not contain any nanomaterials;
- the biocidal product is sufficiently effective;
- the handling of the biocidal product and its intended use do not require personal protective equipment.

On the biocide packaging, the label must show clearly and indelibly several information, such as:

- the identity of every active substance and its concentration;
- the uses for which the biocidal product is authorised;

- directions for use, frequency of application and dose rate;
- directions for the safe disposal of the biocidal product and its packaging;
- the period of time needed for the biocidal effect, the interval to be observed between application and the next use of the product treated.

3.1.3. Other regulations

In the EU, several implementing regulations complete this regulatory corpus, on specific points, such as:

- Regulation N°2073/2005[24], which lays down the microbiological criteria for certain micro-organisms and the implementing rules to be complied with by food business operators when implementing the general and specific hygiene measures referred to in Article 4 of Regulation (EC) N°852/2004;
- Regulation N°931/2011[25], which lays down provisions implementing the traceability requirements set by Regulation (EC) N°178/2002 to food business operators in respect of food of animal origin.

From the 31 December 2020, with the end of the transition period following the UK's exit from the EU, various statutory instruments came into effect to amend EU-derived domestic legislation and led the UK to go its own way. Nevertheless, under the Protocol on Ireland and Northern Ireland, certain European laws continue to apply to Northern Ireland.
Thus, the United Kingdom has implemented European hygiene regulations into the British legislation, without major difference with the original ones:

- The **General Food Hygiene (Amendment etc.) (EU Exit) Regulations 2019**[26] fits the implementation of several regulations, including the N°852/2004 on general rules on the hygiene of foodstuffs;
- The **Specific Food Hygiene (Amendment etc.) (EU Exit) Regulations 2019**[27] fits the implementation of Regulation N°853/2004 on hygiene rules for food of animal origin;
- Regulation N°2017/625 on official controls and other official activities by the competent authorities is implemented in two complementary texts, **The Official Controls (Animals, Feed and Food, Plant Health etc.) (Amendment) (EU Exit) Regulations 2020**[28];
- These texts are gathered in the **Food and Feed Hygiene and Safety (Miscellaneous Amendments etc.) (EU Exit) Regulations 2020**[29], so that they remain applicable with relevance within the UK.

Regarding the quality of water, **The Water Supply (Water Quality) Regulations** remains applicable for each nation (England, Wales, Scotland and Northern Ireland). None of them has been altered as a result of the UK leaving the EU. The European Directive 98/83/EC has been transposed into national legislation with some additional national requirements: **The Floods and Water (Amendment etc.) (EU Exit) Regulations 2019**[30] ensure that all relevant drinking water legislation continues to operate effectively in the UK.
In addition, **The Detergents (Amendment) (EU Exit) Regulations 2020**[31] and **The Biocidal Products (Health and Safety) (Amendment) Regulations 2022**[32] are the retained EU laws on detergents and biocides that apply in Great Britain (England, Wales and Scotland), whereas the EU Detergents Regulation and Biocides Regulation continue to apply in Northern Ireland under the provisions of the Northern Ireland Protocol.

On the whole, all these British laws do not present any significant difference with the European ones.

3.2. Good hygiene practice

Regulation (EC) N°852/2004 recommends referring to relevant codes of practice of the **Codex Alimentarius**.
It is a collection of food standards and internationally adopted texts, to which the World Trade Organization refers, and which are often the source of national legislation. It defines principles and guidelines[33] for the implementation of good hygiene practice applicable throughout the food chain and provide guidance on the application of HACCP principles, such as:

- The premises, equipment and facilities should be located, designed and constructed to ensure that contamination, including airborne, is minimized;
- Care is taken in cleaning procedures so as not to cause contamination of food (pressure level of water splashes);
- Waste is collected and stored in closed containers, does not accumulate or overflow into food preparation and storage areas;
- Packaging design and materials provide adequate protection for products to minimize contamination and should not pose a threat to safety. Any reusable packaging should be suitably durable, easy to clean and, where necessary, to disinfect.

3.3. Hygiene standards

3.3.1. International standards

Any organisation in the food chain can rely on the international food safety management system **ISO 22000**[34]. This standard brings together several specific requirements adapted to different sectors of activity (food manufacturing, catering, agriculture, food packaging manufacture, transport and storage…). By incorporating the principles of the HACCP system developed by the Codex Alimentarius, standard ISO 22000 aims to harmonize the existing standards on the safety of food products. It provides an auditable document that can be certified to companies in the food chain.

The corresponding audit and certification consider the risks associated with the objectives of the organisation and combines the essential and recognized elements to guarantee food safety:

- the company and its context;
- the management system;
- the responsibility of the management;
- the interactive internal and external communication;
- the implementation of good hygiene practices;
- the hazard control, which combines HACCP criteria and prerequisite programs (PRP).

The findings made during an audit are classified into strengths, non-conformities (major or minor) and opportunities for improvement. The deviations identified must give rise to corrective actions. Their relevance and effectiveness are assessed and are condition for obtaining the certification.

3.3.2. European standards

These standards are dedicated to methods aimed at achieving hygiene results, some points of which relate especially to the reuse of packaging. It does not address the subject of the mechanical resistance of reusable items, which is studied by other standards in Section 4.5.

Standard EN 15593:2008

The European standard **EN 15593:2008**[35] is recognized for hygiene management in the food packaging industry. It specifies the requirements applicable to suppliers and manufacturers of food packaging. Requirements are based on hazard analysis and risk assessment related to the hygiene of food packaging, a description of the optimal management system and good hygiene practices.
Requirements are formulated to be easily integrated into management systems such as ISO 22000:

- Hygiene management: distribution of responsibilities, maintenance and cleaning plan, control of documents, management of non-conformities and incidents in order to eliminate them, guarantee of traceability of raw materials and products, conduct of internal audits….;

- Hazard analysis and risk assessment at each stage, from purchases to product delivery: process flow diagram, identification and assessment of the risk level of each hazard, definition of appropriate controls and measures to manage these hazards...;
- Sources of contamination (by foreign body, chemical, biological): control measures such as the prohibition of use in the production area, the identification of cans or the installation of anti-pest devices, cleaning procedures in event of contamination, protection of stored products awaiting distribution, cleaning and maintenance procedures, management of scrap and waste;
- Requirements relating to the plant: maintenance of outdoor areas, buildings, installations and equipment;
- Personnel requirements: management of access points to production and storage areas, work clothes, personal effects, maintenance of changing rooms.

Standard EN 17735:2022

The standard **EN 17735:2022**[36] is inspired by the German standard DIN 17735, which replaced the previous one DIN 10534 on December 2022. It specifies the hygiene requirements for the operation of commercial dishwashing machines in a professional environment, and tests to be carried out on these machines. It also includes main guidelines for the proper operation, care and maintenance of the machines, and defines test methods. General requirements related to the cleaning process are:

- Items should be visually clean under convenient conditions to the customer;
- Items should be dry when removed from the dishwasher basket, droplets remaining on the support points and residual humidity inside the items being tolerated;
- The machine should achieve a level of hygiene that complies with the microbiological requirements specified in the standard;
- The cleaning agents should be eliminated from items to a level that is not harmful to health.

Technical requirements related to packaging materials and machine functionalities are:

- The materials should be resistant to scratches, ageing and corrosion under normal conditions of use;
- Items should be able to be placed easily in the dishwasher basket and in the optimal position intended;
- In Annex B, temperatures and contact times with water are recommended as a guideline to achieve hygienic results for treated items: 90 seconds for batch dishwashers and 120 seconds for conveyor dishwashers.

Table 1 : Recommended temperatures in the dishwashing machine

Step	Temperature (°C)	Measure point
Pre-washing	40 to 50	Pre-washing tank
Detergent circulation	60 to 65	Washing tank
Auxiliary rinsing	60 to 70	Auxiliary rinsing tank
Rinsing with fresh water	80 to 85	Boiler

Other European standards

Finally, several European standards propose test methods to measure chemical efficiency of disinfectants used in food, industrial, domestic, and institutional areas. These approaches can be applied to formulated products or to biocidal active substances:

- Standard **EN 1276:2019**[37] is a quantitative suspension test and specifies a method for testing bactericidal activity by assessing reduction in the number of viable bacterial cells in suspension under defined conditions.

- Standard **EN 1650:2019**[38] is a quantitative suspension test and specifies a method for testing fungicidal or yeasticidal activity by assessing reduction in the number of viable bacterial cells in suspension under defined conditions.
- Standard **EN 13697:2015+A1:2019**[39] is a quantitative nonporous surface test and specifies a method for testing bactericidal and/or fungicidal or yeasticidal activity by assessing reduction in the number of viable bacterial cells and/or mould spores and/or yeast cells dried on a steel carrier under defined conditions.

We notice that another standard, **EN 13727+A2:2015**[40], describes a quantitative suspension test for the evaluation of bactericidal activity in the medical area for chemical antiseptics and disinfectants. It may contain information about disinfection of plastic surfaces or items, but the nature of chemicals and the conditions of use being very different from the food industry, they can not be considered into our work.

4. State of the art of the packaging regulatory framework, institutional analysis and standards

To complete the hygiene framework presented in the previous chapter, this one will be focused on the issue of packaging, from four different angles (Europe, specific national regulations, global, institutional), in order to identify possible difficulties for the reuse of packaging.

4.1. European packaging regulatory framework

In the EU, several directives and regulations rule three main topics related to food packaging: design, food contact, and production & recycling.

4.1.1. Packaging design

Directive 94/62/EC (the so-called Packaging and Packaging Waste Directive) aims to harmonize national measures concerning the management of packaging and packaging waste. The final goal is to prevent any impact thereof on the environment or to reduce such impact, and to ensure the functioning of the internal market. To this end, this directive lays down measures aimed, as priority, at preventing the production of packaging waste and at minimizing its final disposal, by reusing packaging, recycling and other forms of recovering packaging waste:

- Member States may encourage reuse systems of packaging, which can be reused in an environmentally sound manner;
- Member States shall take the necessary measures to attain the following targets covering the whole of their territory:
  - between 50% and 65% by weight of the packaging waste will be recovered by 2021;
  - with the same time limit, between 25% and 45% by weight of the totality of materials contained in packaging waste will be recycled with a minimum of 15% by weight for each material.
- Member States shall, where appropriate, encourage the use of materials obtained from recycled packaging waste for the manufacturing of packaging and other products;
- Member States shall take the necessary measures to ensure that systems are set up to provide for the return and/or collection of used packaging and/or packaging waste from the consumer. The target is to route packaging waste to its most appropriate waste management alternative, reuse or recovery (including recycling), in order to meet the objectives laid down in the Directive;
- To facilitate collection, reuse and recovery including recycling, packaging shall indicate the nature of the packaging material(s) used, thus as to facilitate its identification and classification by the concerned waste treatment industry.

Directive (EU) 2018/852[41] amends Directive 94/62/EC by proposing several measures that Member States shall implement on their territory and by giving new recycling targets:

- National programmes, incentives through EPR schemes and use of economic instruments to encourage the application of the waste hierarchy (see Annex IV bis from Directive 2008/98/EC) and to prevent generation of packaging waste;
- Implementation of EPR schemes for all packaging by 31 December 2024.
- Use of deposit-return schemes, economic incentives and setting up of a minimum percentage of reusable packaging placed on the market every year for each packaging stream, in order to encourage the increase in the share of reusable packaging placed on the market and of systems to reuse packaging;
- Setting up of new recycling targets:
  - at the latest December 31st 2025, a minimum of 65 % by weight of all packaging waste will be recycled and minimum targets by weight for recycling will be met regarding specific materials contained in packaging waste (for plastic, 50% of the material);

- at the latest December 31st 2030, a minimum of 70 % by weight of all packaging waste will be recycled and minimum targets by weight for recycling will be met regarding specific materials contained in packaging waste (for plastic, 55% of the material);

Directive 2019/904 – Faced with the magnitude of the problem of waste management at the global level, **Directive (EU) 2019/904 (the so-called Single-Use Plastics Directive)** sets out new measures to prevent littering, especially in marine environment:

- Reduction in the consumption of several categories of single-use plastic products, such as cups for beverages (see details in Part A in Annex);
- Prohibition to place on the market other categories of products, such as food containers made of expanded polystyrene (see details in Part B in Annex);
- Design requirements for beverage bottles, whose caps and lids have to remain attached to the containers during the products' intended use stage;
- Targets to be reached on the content of recycled plastic in PET beverage bottles:
  - from 2025, beverage bottles listed in Part F of the Annex contain at least 25 % recycled plastic;
  - from 2030, they contain at least 30% recycled plastic.

It is essential to note this directive is applicable for single-use plastic products and does not concern reusable plastic products.

Revision of Directive 94/62/EC – Given the exponential growth of packaging waste in recent years and the need to implement new means of management, Directive 94/62/EC is currently being revised and may contain additional measures to the prohibition of some products of Directive 2019/904. A draft was published in November 2022 as "Packaging and Packaging Waste Regulation", the outline of which is summarised in Section 5.1.

4.1.2. Packaging food contact

Regulation (EC) N°1935/2004[42] concerns packaging materials and safety. It aims to ensure the effective functioning of the internal market in relation to the materials and articles intended to come into contact directly or indirectly with food, whilst securing a high level of protection of human health. These materials should not transfer their constituents to food in quantities which could:

- endanger human health;
- bring about an unacceptable change in the composition of the food;
- bring about a deterioration in the organoleptic characteristics thereof.

Measures specific to a category of materials may be adopted and shall require that materials covered by those measures be accompanied by a written declaration stating that they comply with the rules applicable to them.
A project of revision of this Regulation is ongoing and summarised in Section 5.2.

Regulation (EU) N°10/2011[43] is a specific measure of Regulation N°1935/2004, applicable for plastic materials. It provides a list of authorised substances which may be intentionally used in the manufacture of plastic materials and articles, and establishes migration limits:

- Plastic materials and articles shall not transfer their constituents to foods in quantities exceeding the specific migration limits (SML) set out in Annex I of the Regulation;
- Plastic materials and articles shall not transfer their constituents to food simulants in quantities exceeding 10 milligrams of total constituents released per dm^2 of food contact surface (mg/dm^2). It is called the overall migration limit.

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- A declaration of compliance shall be made available by the manufacturer to the national authorities, as required by Regulation N°1935/2004. It shall contain the conditions and results of testing, calculations, other analysis, and evidence on the safety or reasoning demonstrating compliance.

- Annex V of the Regulation gives guidance on specific migration test methods, in particular for reusable materials and articles. When a material or article is intended to come into repeated contact with foodstuffs, the migration test must be carried out three times on a single sample, each time using a different portion of simulant. Compliance is checked on the basis of the level of migration observed during the third test.

Regulation (EU) 2020/1245[44] amends the N°10/2011, with regard to reusable materials and articles. It specifies that "a material or article shall never be considered to comply with this Regulation if in the first test a substance that is prohibited from migrating in detectable quantities is detected". Even with this addition, this protocol may be insufficient to assess the risk of migration for reuse, the reasons for this are indicated in Section 7.1.
A draft revision of this Regulation is ongoing and summarised in Section 5.3: given that a revision of the N°1935/2004 is also in progress, and that the two are linked, it will be essential to carefully ensure that the two future regulations are consistent.

The **Regulation N°1907/2006**[45] **(the so-called REACH Regulation)**, aims to better protect human health and the environment against the risks associated with all types of chemical substances (industrial processes, daily life, etc.). It establishes procedures for the collection, evaluation of information on the properties and hazards of chemical substances, based on information registered by companies, authorisation and restrictions on these substances. The ECHA conducts assessments to verify that registrations comply with the legislation.
The REACH Regulation is implemented by the application of **Regulation N°1272/2008**[46] **(the so-called CLP Regulation**, for Classification, Labelling and Packaging of chemical substances and mixtures), which requires manufacturers and users of chemicals to classify, label and package them in an appropriate way before placing them on the market. It impacts a large number of regulations and products, such as biocides, detergents, hazardous waste, but also toys, cosmetics and electric batteries.
The REACH Regulation is also being to be revised, which is explained in Section 5.4.

4.1.3. Packaging production and recycling

Regulation (EC) N°2023/2006[47] lays down the rules on good manufacturing practices for the materials and articles intended to come into contact with food, listed in Annex I to Regulation (EC) N°1935/2004. It shall apply to all sectors and to all stages of manufacture, processing and distribution of materials. Main object of the rules are:

- The manufacturer shall establish, implement and ensure adherence to an effective and documented quality assurance system, in order to ensure the required quality of materials to comply with the rule;

- The manufacturer shall establish and maintain an effective quality control system, which ensures implementation and achievement of good manufacturing practice;

- The manufacturer shall establish and maintain appropriate documentation with respect to specifications, manufacturing formulae and processing which are relevant to compliance of the finished material/article.

Regulation (EU) 2022/1616[48] sets rules on the operation of all recycling stages in order to prevent contamination, from pre-processing to post processing (documentation, labelling, collection, etc.), such as:

- Requirements relating to the development of new recycling technologies and the operation of facilities applying them;

- Requirements for monitoring contamination levels;

- Evaluation and authorisation procedures by the EFSA and the European Commission, of recycling technologies, including chemical recycling or the incorporation of recycled plastic behind a functional barrier;

- Provisions relating to the use of recycled plastic behind a functional barrier.

One of the main points of this regulation is that mechanical PET recycling, on one hand, and product loops in a closed and controlled chain, on the other hand, may be considered as suitable recycling technologies to recycle waste plastic into plastic meeting the requirements on suitability for food-contact (Regulation N°1935/2004). It opens the door to the potential evaluation of chemically recycled materials for food contact, under certain conditions, although the previous **Regulation (EC) N°282/2008**[49] allowed it with only post-consumer and mechanically recycled PET and PET from closed and controlled circuits, under certain conditions.
For the mechanical post-consumer PET recycling processes, the efficiency of the decontamination depends on the specific configuration of the process (severity and duration of the treatment of the plastic input): so, it should be subject to individual authorisation. Unlike it, it is not necessary to require the authorisation of individual recycling processes based on closed and controlled schemes preventing contamination. In the latter case, the introduction of contaminants in the scheme is supposed to be sufficiently controlled (e.g. contaminants are easily and comprehensively identified) so that their removal can be efficiently carried out and verified : either after a cleaning procedure in the case of reusable packaging, or after a decontamination process in the case of recycled materials.

4.1.4. Non-food packaging

Regulation (EC) N°648/2004 on detergents detailed in Section 3.1.2 does not mention any requirement on the packaging, unlike that of cosmetic products.

Regulation (EC) N°1223/2009[50] establishes rules to be complied with by any cosmetic product made available on the market, in order to ensure the functioning of the internal market and a high level of protection of human health.
Cosmetic products shall not contain any of the prohibited substances listed in Annex II and restricted substances which are not used in accordance with the restrictions laid down in Annex III. Additional restrictions regarding colorants, preservatives and UV-filters are listed respectively in Annexes IV, V and VI. However, the non-intended presence of a small quantity of a prohibited substance, stemming from impurities of natural or synthetic ingredients, the manufacturing process, storage, migration from packaging, which is technically unavoidable in good manufacturing practice, shall be permitted provided that such presence complies with requirements of safety, presentation and labelling (potential instructions for use and disposal...).

Thus the presence of impurities and traces of prohibited substances, including for the packaging material, must be evaluated and this evaluation must appear in a Product Information File, accessible to the authorities of the Member State. These data must allow to assess the interactions between the cosmetic product and the packaging, and the possible risks associated with the packaging material.
It must therefore be demonstrated that the packaging used is safe and does not interfere negatively with a developed formulation. To this date, as there is no mandatory operating procedure for the cosmetics sector, the usual practice of the cosmetics manufacturers is to align their requirements with those of the regulations on food packaging, which allows them to maximize safety guarantees.

4.2. National regulations on reusable packaging in BUDDIE-PACK partners

Even though the EU has not yet set specific measures and targets for the reuse of packaging, we observe that some BUDDIE-PACK partners' countries have approved laws which tend towards this direction, in order to provide a framework on a subject still little explored. This section aims to scan some representative countries, i.e. France, Spain, Germany, The Netherlands, Hungary and United Kingdom.

4.2.1. France

The **Egalim Law n°2018-938**[51] was adopted on October 2018 and lays down several measures improving the balance of commercial relations in the agricultural and food sector and favouring healthy, quality and sustainable food. It bans the use of plastic food containers for cooking, heating and serving food in the collective catering

services of universities, schools and establishments hosting children under six-year old. In local authorities with less than 2,000 inhabitants, this rule is applicable by 1 January 2028.
This law follows complaints from parents' associations, which highlighted the uncertainties about the risks of migration of substances from plastic to food: this is why it bans not only plastic single-use containers, but all plastic containers. Thus, since this vote, the law has already pushed many establishments to begin their transition and to abandon single-use plastic containers for stainless steel trays, so as to anticipate potential obstacles, to implement new logistic loops and to define the best economic model.

The **Anti-Waste Law for a Circular Economy n°2020-105 (AGEC)** was voted on February 2020: it includes a transposition of the SUP Directive 2019/904 and sets up also several targets and measures to develop the reuse of packaging:

- Main quantified targets
  - France has set the goal of reaching the end of single-use plastic packaging by 2040.
  - To do this, France adopts a national roadmap aiming to reach a proportion of 5% of reused packaging on the market in France in 2023 and 10% of packaging in 2027;
  - This strategy requires to reduce single-use plastic packaging by 20% by the end of December 2025, of which at least 50% reached through to the reuse of packaging;
  - The law sets the target of reducing the number of single-use plastic beverage bottles placed by 50% by 2030.

New targets will be set or updated every 5 year.

- Main mandatory measures
  - Companies in charge of managing waste, devote annually at least 5% of the amount of the contributions they receive to the development of solutions for the reuse of packaging;
  - From 1 January 2021, takeaway beverages sold in a reusable container presented by the consumer rather than in a disposable cup are sold at a cheaper price;
  - From 1 January 2021, the free distribution of plastic bottles containing drinks in establishments open to the public, business offices and during sporting, festive or cultural events is not allowed anymore;
  - From 1 January 2022, cups, cutlery, plates and containers used as part of a daily home meal delivery service (at least 4 deliveries per week) are collected from beneficiaries for reuse;
  - From 1 January 2023, catering establishments (20 places minimum) have to serve meals and drinks consumed on-site in reusable containers with reusable cutlery;
  - From 1 January 2025, the use of plastic cooking, reheating and serving food containers in pediatrics, obstetrics and maternity wards will be banned.

These measures are significant additions to Directive 94/62, and are rather stronger and concern more sectors than those of the revision ongoing, like explained in Section 5.1.

To this date, there is very few official assessment of the application of the AGEC law by the concerned actors.
However, in June 2021, the NGO Zero Waste France made merchants aware of the application of the discount on drinks in reusable containers, on which they were late and not all well informed. It seems now that the measure is effective in these shops.
In the sector of home meal delivery service, the application of the measure in force since January 2022 is unequal. The reuse of packaging significantly challenges the technical, logistical and economic parameters (heat treatment during packaging, conservation, transport, etc.), and the uses of the beneficiaries (ease of opening, return of containers, etc.). For these reasons, many experiments are still in progress and the most of the actors is not yet able to respect the law.
Then, after a mobilization of Zero Waste volunteers to incite the on-site catering to comply with the measure on reusable packaging in force since January 2023, the latest report from the Ministry of Ecological Transition announces that four brands are fully compliant, about forty have submitted a corrective action plan and two still

do not have a plan. These action plans aim to bring restaurants into compliance by the end of June, but no results have been published to date.
Finally, the report "Counting the reuse of packaging in France", published in February 2023 by the Ademe, has not yet resulted in the total calculation and quantification of the share of reusable packaging on the French market.

Moreover, the **Law Climate and Resilience n°2021-1104**[52] was voted on August 2021 and sets a goal to retailers: from 1 January 2030, retailers with an area greater than or equal to 400m2 devote to the sale of products presented without primary packaging, including bulk sales, at least 20% of their sales area.

This set of measures aims to make the reuse of packaging more visible in different sectors and encourage consumers to adopt more sustainable uses. This national strategy should also encourage manufacturers to test reusable packaging and gradually include it in their operating standards.

4.2.2.Spain

On February 2019, **Law 8/2019 on Waste and Contaminated Soils of the Balearic Islands**[53] (Llei de residus i sòls contaminats de les Illes Balears) was precursor and set next goals to reduce packaging waste:

- Two reduction targets of packaging waste are voted, compared to 2010: -10% by 2021, -20% by 2030. To this date, no result on the first reduction target of packaging waste has been communicated.
- In hotels, restaurants and cafés, the share of reusable beverage containers should reach by 2030 40% for water, 80% for beer and 70% for soft drinks;
- In the other channels (retailers, etc.), the share of reusable beverage containers should reach 15% by 2030.

This law was followed by the **Royal Decree 1055/2022 on packaging and packaging waste** (Real Decreto de envases y residuos de envases), which was voted in December 2022. This decree includes a transposition of the SUP Directive 2019/904 and sets new reduction targets of packaging waste (-13% by 2025 compared to 2010, and -15% by 2030) and of single-use plastic bottles (-20% by 2030, compared to 2022). According to Spanish legislation, these national targets do not cancel those voted in Balearic Islands, which are higher.

To reach these objectives, the law sets several measures:

- Since June 2023, food retailers whose area is equal to or greater than 400m2 have to devote at least 20% of their sales area to the offer of products presented without primary packaging, including sale in bulk or through reusable packaging. Considering the recent application of this measure, there is no feedback on its results yet. Moreover, it can be recalled that this measure is also included in the French AGEC law.
- In hotels, restaurants and cafés, the share of reusable beverage containers should increase gradually and reach several targets depending on the type of product by 2025, 2030 and 2035: from 30% to 50% for water, from 80% to 90% for beer, from 60% to 80% for soft drinks, from 20% to 30% for other drinks;
- In food retail stores, at least 10% (expressed in hectoliters) of the beverages of the categories mentioned previously and marketed on the household market, will have to be placed on the market in reusable containers by 2030. Moreover, the number of beverage references in a reusable container should increase gradually and reach several targets depending on the sales area:
    - at least 1 reference by 2027 for commercial areas of less than 120 m2;
    - at least 3 references by 2027 for ones from 120 to 300m2;
    - at least 4 references by 2025 for ones from 300 to 1000m2;
    - at least 5 references by 2025 for ones from 1000 to 2500m2;
    - at least 7 references by 2025 for ones of 2500m2 or more.

- Compared to the total weight of containers marketed in the household channel, the part of reusable ones should be 5% in 2030 and 10% in 2035.
- Compared to the total weight of commercial and industrial containers, the part of reusable ones for each category should be 20% in 2030 and 30% in 2035.

4.2.3.Germany

After the transposition of the SUP Directive 2019/904 in July 2021 in the Einwegkunststoffverbotsverordnung (EWKVerbotsV), the **Packaging Act VerpackG** was updated in September 2021 with some additions regarding the reuse of packaging:

- From 1 January 2023, for on-site food consumption, take-away or delivery, the merchant should offer a reusable alternative to single-use packaging and inform the consumer on it by clear signs;
- The Act prohibits on offering this alternative at a higher price or under less favorable conditions than single-use packaging;
- This regulation only applies for businesses with five employees or more, or with a sales area of 80m2 or more.

4.2.4.The Netherlands

On March 2022, the **Regulation on single-use plastic products**[54] (Regeling kunststofproducten voor eenmalig gebruik) was completed with a transposition of the SUP Directive 2019/904 and some incentives for the reuse of packaging:

- From July 2023, for take-away or delivery of food which can be directly eaten without heat or any other preparation, the merchant should offer a reusable alternative to single-use packaging or serve the customer in his own container, and should propose an additional cost for consumption into a plastic single-use cup or packaging. The rules also apply to disposable cups and food packaging made from bioplastics including biodegradable plastic or plastic made from renewable raw materials, but not packaging made of 100% paper;
- From January 2024, for on-site consumption, plastic single-use cups and packaging will be banned, unless the operator meets the collection targets for recycling set in the Regulation. This collect must allow the realization of a high quality recycling and only applies to products that can be recycled into materials in contact with foodstuffs, i.e. PET cups and food packaging, in view of Regulation 2022/1616.

Although this regulation puts on the same level reusable and recyclable packaging and lets the choice to the operator between the two options, this gradual introduction of the reuse of packaging reveals that recycling may not be sufficient to achieve European objectives of waste management.

4.2.5.Hungary

Even though Hungary transposed the Directive 94/62 in the Decree n°442 of 2012[55] (XII. 29., Korm of the Government on packaging of goods distributed in Hungary and on waste management activities) and the SUP Directive 2019/904 in two decrees which are in force since July 2021, we have not identified any specific measure in favor of the reuse of packaging:

- The **Government Decree N°301/2021**[56] on restricting the placing on the market of certain single-use products: it prohibits especially to put on the market several categories of plastic products (plates, containers made of expanded polystyrene, plastic cups including their caps and lids, etc.);
- The **Government Decree N°349/2021**[57] on reducing the impact of individual plastic products on the environment: it sets additional measures, such as the banning of the free availability of certain single-use plastic products and plastic beverage cups (including plastic coated paper cups), and targets for incorporating recycled plastic into PET beverage bottles.

4.2.6. United Kingdom

Like for the hygiene issue, which is explained in Section 3.1.3 of this report, the UK has to implement the European packaging regulations into its own law. Its four nations (Wales, England, Scotland and Northern Ireland) are currently discussing about it and have not yet reached agreement on all points, which are reported in Section 5.5. However, the regulations in force to date can be summarised here.

In the UK, product packaging materials are subject to various regulations and standards, applicable both to packaging materials as a category, and product packaging for consumer products. The laws are overall similar across the UK while it includes a number of devolved administrations such as Wales, Scotland or Northern Ireland. In some cases, there are different referable laws in Scotland and Northern Ireland but the principles are much the same. At this date, we have not identified any specific measure to the reuse of packaging.

On design aspects of the packaging issue, the main regulations are following:

- **The Producer Responsibility Obligations (Packaging Waste) Regulations 2007**[58] (2007 N°871) and **The Packaging (Essential Requirements) Regulations 2015**[59] (2015 n°1640), i.e. "Packaging Waste Regulations", cover recycling and recovery. They implement the Packaging and Packaging Waste European Directive (94/62/EC). The essential requirements are found in Schedule 1 of the legislation. It contains specific requirements that relate to the manufacturing and composition of packaging, their reuse and their recoverable nature.
- **The Environmental Protection Act 1990**[60] (EPA 1990) (1990 c. 43) includes dispositions regarding waste obligations such as unauthorised or harmful deposit, treatment or disposal of waste, waste duty of care in its Part II (namely « Waste on Land »). The EPA 1990 had been amended several times. The last changes to legislation came in on March 2022 and entered in force from 5 January 2023 for the first changes.
- **The Plastic Packaging Tax (General) Regulations 2022**[61] (2022 n°117) has introduced the Plastic Packaging Tax (PPT) and set out its framework and key definitions. It outlines specifically the scope and procedures of the tax that came into force on 1 April 2022. The tax is aimed at encouraging the use of more sustainable plastic packaging, increasing the use of recycled plastic and helping to reduce plastic waste.
- As concerns the transposition of the SUP Directive and the restrictions on single-use plastic products, the Government has not yet approved a homogeneous law throughout the whole territory. As this point is still debated, it is detailed in Section 5.5.

In matter of food contact, European regulations N°1935/2004 and N°10/2011 (and its amendment by Regulation 2020/1245) should continue to be observed in the UK when considering importing or manufacturing FCM (Food-Contact Material) products.
In addition, the British regulation includes **The REACH etc. (Amendment etc.) (EU Exit) Regulations 2020**[62], which is very similar to the European one. Two of main priorities have been identified for the 2022 to 2023 UK REACH work program, namely:

- acting on the recommendations of a Regulatory Management Options Analysis (RMOA) about PFAS (per- and polyfluoroalkyl substances);
- leading an evidence project on identifying and managing the risks posed by intentionally added microplastics.

Regarding production and recycling, the regulation N°2023/2006 on good manufacturing practice for FCM should also be applied in the UK.

Although the Regulation (EU) 2022/1616 « on recycled plastic materials and articles intended to come into contact with food » entered into force on 10 October 2022, the previous Regulation (EC) N°282/2008, repealed by the 2022/1616 in EU, remains applicable in the Great Britain market, as a clear sign of divergence between EU and UK regulatory requirements following Brexit.

4.3. United Nations Treaty on plastic pollution

Beyond these regulations that were already adopted to favor the reuse of packaging, we can see that this dynamic is much broader than Europe. Indeed, even if China and several Asian countries banned import of waste from all over the world, other countries are still invaded by waste, hoping to find economic opportunities there but do not have recycling facilities suitable for human health and environment, and their dumping in oceans continues. In the same time, scientists have more and more experience to study and assess the negative impacts of plastic pollution on the human health and on the biodiversity.

In this context, the United Nations Environment Assembly, the highest international body on these subjects, adopted in March 2022 in the Kenyan capital Nairobi a motion creating an Intergovernmental Negotiating Committee responsible for drafting a text "legally binding" by 2024. The committee met in Uruguay in the end of 2022 for a first session to define the scope of the treaty, then in Paris in June 2023 for the second one.

This last session especially allowed to discuss the objectives and contours of the future treaty and to collect the opinions of the States on the institutional architecture of the future agreement, based on twelve possible scenarios of obligations identified by the United Nations Environment Program (UNEP)[63]. In addition, the financial mechanisms for implementation and methods of cooperation between the States and the future framework for evaluating progress have been debated. Major plastic manufacturing countries (Gulf countries such as Saudi Arabia, as well as Russia, China, India and Brazil) have expressed their strong opposition to the possibility that the treaty could be voted without unanimity.

These work sessions should lead to a first proposition of text by the third one: two of the main stakes will be the part of binding actions over voluntary ones and the approval rules of the text. Next sessions are planned in November 2023 in Nairobi, Kenya, then April 2024 in Ottawa, Canada, and October 2024 in South Korea.

4.4. Institutional analysis

Several associations and NGO defend the environmental benefits of reuse, promote a change in consumer habits and follow the evolution of awareness of this societal issue. They are also stakeholders in debates with the European Commission, the food and packaging manufacturers, and all actors concerned by this matter.

4.4.1. The Ellen MacArthur Foundation

The Ellen MacArthur Foundation is one of the leading institutions and has greatly contributed to the re-discovery and formalization of reuse systems and has been influential in the terminology shaping of different reuse- and refill models. Together with the UNEP, the Global Commitment has been established in 2018. It works with voluntary industry targets and the tracking of those and has, to this date, over 500 signatories of which a total of 135 signatories from industry players including retailers, brands, producers, and waste management companies is eligible to report, as well as twelve government signatories eligible to report. The Global Commitment has set broad targets for 2025 but leaves the way of implementation open to signatories. Targets are:

- Ensure 100% of plastic packaging is reusable, recyclable or compostable
- Increase the share of post-consumer recycled content across all plastic packaging used
- Decrease the use of virgin plastic in packaging
- Take action to move from single-use towards reuse models where relevant
- Eliminate problematic or unnecessary plastic packaging

Visibly, reuse is highlighted as a tool of the overall strategy but is mixed with other pathways such as recycling and without a clear critical limit. While these targets have served as an initial guidepost for international and industry wide targets, governments and organisations have improved to set more measurable targets to evaluate progress.

4.4.2.The European Reuse Alliance

The European Reuse Alliance (New ERA) in collaboration with Planet Reuse have initiated the rEUse campaign, which amongst others provides policy recommendations on EU basis. Subject to the recommendations are various packaging formats, amongst others take-away food and beverage containers. The rEUse campaign builds on the idea of existing legislative framework such as the PPWR. Core to the recommendation is the increase of proposed reuse targets of the PPWR. Specifically:

- Food take-away containers: 10% by 2030 and 40% by 2040
- Beverage containers: 20% by 2030 and 80% by 2040

However, to assure effectiveness, the EU Member States are to set more ambitious targets according to already existing reuse rates and targets in place. Furthermore recommended is a standardisation of reuse systems and assessment methods. Standardisation is to include and scale pooling systems for the optimisation of logistics, ecological effectiveness of reusable packaging, and allow ease of use supporting consumer acceptance. Addressed to EU standardisation bodies is the recommendation to build upon existing practices and research. Standardisations shall be built upon ongoing initiatives and existing standards among EU countries. The expansion of DRS (Deposit Return Systems) for reuse is also recommended to further encourage consumer engagement with reuse systems.

Further recommendations concern LCA practice, EPR schemes and reuse governance. To address the issue of the circulation of ambiguous LCA´s to assess environmental performance of reuse, rEUse recommends a standardisation of assessment methods to assure reliability, transparency and comparability of data. For this, collection targets are recommended. Moreover, it is suggested to create EU observatory as a central point for EU wide reuse developments. This could be facilitated by the Directorate General Environment (DG ENV) and Eurostat.
It is recommended to integrate eco-modulation into EPR schemes as a tool to encourage better product design and reuse. Furthermore, a fund for reuse shall be made available by for e.g. PROs.

4.4.3.Zero Waste Europe

Zero Waste Europe (ZWE) has proposed a set of regulations to support the development of a policy framework aiming at the implementation of reuse for take-away food and beverages as well as e-commerce (May 2022). In the following, policies for take-away food are explored as being most relevant to BUDDIE-PACK use cases. Generally, a reduction of single-use packaging for food, beverages, e-commerce, and household care products by 50% until 2030 is recommended based on the significant savings of resources, emissions and costs.
For the implementation, ZWE recommends specific reuse targets per type of packaging, based on their readiness to switch and the environmental footprint of products. For take-away food- and beverage packaging, the following targets are recommended:

- 2025: a levy of 0,50€ on all single-use packaging items to be re-invested in reuse systems such as infrastructure development;
- 2026: for on-the-go solutions, refillable or reusable packaging to be offered at the point of sale;
- 2027: 75% of take-away food and beverages are sold in reusable packaging. This target is increased to 90% by 2035;
- 2027: 100% of packaging used in eat-in situations is reusable.

To achieve the transition, several levers are suggested, intended to the various actors along the value chain, for designers, consumers and points of sale: economic incentives, support of reuse initiatives, supporting the implementation of reuse and refill systems.
To de-encourage consumers to choose of single-use packaging, a visible extra fee on single-use packaging at the point of sale should be added. 0,10 € are suggested.
In addition, EPR schemes shall dedicate 10% of their budget to finance reuse and refill infrastructure to create a market pull.
Points of sale, including retailers and HORECA actors, must support reuse initiatives by providing reuse and refill options, offering take-back options and accepting BYO. Those should be supported through DRS with guidelines to set-up pooling systems and to develop a joined infrastructure, such as collection points and washing. Finally, parameters to align packaging design and return incentives between companies shall also be provided for a harmonisation of reuse systems.

4.4.4.Upstream

Upstream has collected best practices from all over the United States and has developed a policy roadmap to reuse. The document refers to seven strategies and nine policy tools to enhance and scale reuse paying attention to different players. Despite being focused on the US, suggested strategies and policies measures can also be relevant to non-US contexts such as the EU.

Strategy N°1 addresses reduction of disposables through sector wide targets for food and beverage packaging in on-site, take-out, delivery and event situations, as well as for consumer goods including household and personal care packaging. Targets suggest a 50% reduction for the coming 10 years based on a percentual increase every year. This will include reporting measurements, which are non-weight based in order to avoid the development of light-weight packaging substitutes. Furthermore, accessories shall only be provided on request and not by default. The strategy shall be supported through bans coming with an obligation of points of sale offering reusable solutions.

Strategy N°2 focuses on the transition to refill and reuse. This includes sector-wide mandatory reuse targets:

- Food-service packaging: 100% for beverage- and food packaging for eat-in and 75% for take-out packaging
- Grocery store products: 75% for household cleaning, 50% for personal care and 75% for beverages.

Non-compliance will be penalised with unit-based charges.
Reuse shall further be used for governmental procurement and workplaces such as a minimum of 10% of beverages being provided in reusable packaging formats.

Strategy N°3 looks at producers' accountability with a link to EPR policy.
EPRs shall include targets for packaging reduction as well as reuse to be implemented in form of a phase-out with a 50% target within 10 years (unit not weight based). Furthermore, reusable packaging must achieve a minimum return rate of 80% to be recognized as reusable packaging. Generally, EPRs should include better design, lowered environmental impact in the production stage, and other aspects that contribute to circularity. These aspects as well as reuse shall be recognized through eco-modulation. To assure a reliable system, EPRs must include auditing. Producers are as well to develop an inclusive return infrastructure that also allows participation without digital access.

Strategy N°4 highlights the justice and equity aspects for policy development. Communities shall be able to participate in the policy building process.

Strategy N°5 points at economic support businesses. This can include tax incentives for reuse options (not to be combined with recycling tax incentives!). Other options can be accelerated depreciation for businesses switching and providing reuse as well as grants for reuse.

Strategy N°6 and N°7 focus on precautional actions. On the one hand, this includes to only allow packaging that is locally practically recyclable based on existing infrastructure. Furthermore, critical chemicals are banned as well as critical materials such as polystyrene. The same shall account for single-use as well as reusable packaging.

For the realisation of strategies, nine policy tools are suggested:

1. **Incentives** including deposit schemes to assure high return rates.
2. **Regulatory targets** based on rates and dates to be measured individual per company. Non-compliances are levied with penalties.
3. **Bans** on single-use items for different product groups. With this, not only throw-away plastic is banned but also substitute materials, creating a demand for reuse and preventing other resource intense consumption. Moreover, critical chemical groups to be banned as additives.
4. **Obligations** for reuse including reusable packaging not being more expensive than single-use options. Reuse must also include take-back options.
5. **Consumer charges, taxes and fees**: those are as well relevant to induce behavioural change. Depending on the format, either governments (taxes) or businesses (charges) create revenue streams to be reinvested in reuse.
6. **Discounts and charges** are both options to incite consumers to choose for reuse. However, research shows (US) that most consumers are loss-averse, pointing at charges being more effective to steer behaviour especially when single-use and reuse have to compete in one setting.
7. **Tax incentives** for businesses which provide reusable options for both B2C and B2B. This may also include unpacked options as well as bulk-filling stations.
8. **EPR** is mainly used for downstream solutions (recycling) but should increasingly embody upstream solutions.
9. **Barrier removal for reuse such as food safety codes.**

Beyond these well-known NGOs, many others, smaller and on a national scale, also communicate on the reuse of packaging and encourage changes in use. For example, in France, the association No plastic in my sea published in March 2023 a report of 12 recommendations also including a library of 500 alternatives to single use[64].

4.5. Design standards

These standards are dedicated to methods aimed at designing items adapted to repeated washing cycles. It does not address the subject of the hygiene, since the temperature of the test does not comply with the reference standard which is presented in Section 3.3.2.

Standard EN 12875-1:2005 (part 1)

The standard **EN 12875-1:2005 (part 1)**[65] defines a test method for determining the mechanical strength in the dishwasher of articles for household use, which should serve as a reference method for dishwasher resistance. It applies to dish as well as household accessories. It does not define the number of wash cycles that a given product must withstand, but it subjects unused items to at least 125 standardised test cycles. The washing procedure requires a temperature of 60°C during the washing step and 65°C during the rinsing one. These samples are checked after completion of the planned number of cycles: control points are established depending on the type of product and these controls are carried out under standardised conditions (brightness, corrected normal vision, at a distance of 30±10cm, at different viewing angles).

Standard UNE-53928:2023

In addition, a new European standard is going to be designed from an existing Spanish one, the **UNE-53928:2023**[66]. The draft specifies a test method to verify that plastic tableware manufactured by thermoforming or injection moulding process can be used at least 5 times after each dishwashing process. Like the previous standard EN 12875-1, the washing procedure requires a temperature of 60°C during the washing step and 65°C during the rinsing one, and sample control points are also the same. The minimum number of wash cycles that the sample must withstand to be considered reusable is five, but depending on his need, the test applicant may request to test a larger number of cycles.
With a lower number of test cycles, this draft seems to be a less demanding version of the standard EN 12875-1.

In both cases, this is essential to recall these standards do not fit to the industrial conditions of the reuse of packaging, where the business operator manages the safety. The temperature being much lower than that of standard 17735, which is the reference on the hygiene issue, we can tell that these conditions fit to a domestic reuse, where the safety is managed by the consumer.

5. Regulatory outlook related to ongoing revisions

5.1. Packaging and Packaging Waste Regulation (PPWR)

According to the OECD (Organisation for Economic Co-operation and Development), global plastics production more than doubled between 2000 and 2019 due to population growth and rising incomes. In the absence of new measures, the use of plastics is expected to triple from the 2019 level (460 million tons), reaching 1231 million tons in 2060[67].
In addition, according to Plastics Europe's latest report on key data in 2022[68], 17.9 million tons of post-consumer plastics packaging waste were collected in 2020 in the European Union, of which 17% went to landfill. These figures vary greatly from one country to another. The rate of discharge varies from 0% to more than 70% and reaches 50% in 10 countries of the European Union.

Given these data, a new European regulation should replace in coming years the Directive 94/62/EC on Packaging and Packaging Waste, in order to regulate the consequences to be expected from the increase in global plastic production. A draft was proposed in November 2022[69], amendments were tabled until May 2023 and the regulation is expected to be voted by the Parliament in October 2023. This is essential to note that unlike the directive in force, which was transposed by each country into its own legislation, this draft will probably be a regulation applicable as it stands in all Member States of the European Union, so as to promote the standardisation of rules throughout Europe.

The proposal notes that Directive 94/62/EC has not been able to reverse the growth trend of packaging waste, accentuated by new consumption habits (on-the-go consumption, increased online sales and home deliveries). In order to reduce the increasing proportion of single-use packaging and the growing amounts of packaging waste generated, the draft lays down reduction targets of these waste per capita to be achieved by 2030 (5% compared to 2018), 2035 (10%) and 2040 (15%), in sectors which have the greatest potential for reduction, namely food and beverages for take-away and transport packaging.

Several main points could change significantly the current rules for the reuse of packaging:

- Article 7 lays down minimum recycled content in plastic packaging: the values are being discussed and, according to the draft of November 2022, may vary between 10 and 35% from 2030 and between 50 and 65% from 2040, depending on the type of packaging and material.
- Article 10 lays down the requirements for reusable packaging, which must be part of a system for reuse compliant with the minimum conditions as set out in Annex VI of this Regulation (governance, collection and storage requirements, reconditioning rules, information rules and hygiene standards on refill stations, etc.);
- Article 11 requires that packaging bear a label containing information on its composition (material, recycled content, biobased content) and on its reusability, and a QR code or other type of digital data carrier that provides further information on the availability of a system for reuse and of collection points, on their tracking and on the calculation of trips and rotations. The markings shall be placed, printed or engraved visibly, clearly legibly and indelibly on the packaging, or on the grouped packaging if it is not possible;
- Article 25 requires economic operators who offer products for purchase through refill to provide certain information to end-users and to ensure the compliance of refill stations with the requirements laid down in Part C of Annex VI (types of containers that may be used to refill, hygiene standards, responsibility of the end user related to the health and safety regarding the use of the containers).
- Article 26 lays down a number of quantified targets on reuse and refill for different sectors and packaging formats, by 2030 and 2040. These operators will have to make available their products within a system of reuse or by enabling refill:
    - Distributors of cold or hot beverages filled into a container at the point of sale for take-away;

- HORECA actors for take-away ready-prepared food, intended for immediate consumption without the need of any further preparation, and typically consumed from the receptacle;
- Manufacturers and distributors of alcoholic beverages excluding wine (beers, ciders, etc.);
- Manufacturers and distributors of wines;
- Manufacturers and distributors of non-alcoholic beverages (water, soft drinks, juices, smoothies without milk, etc.);
- Economic operators using transport packaging in the form of pallets, plastic crates, foldable plastic boxes, pails and drums.

Given the nature of the products and the differences in their production and distribution systems, deposit and return systems should however not be obligatory for packaging for wine, aromatised wine products, spirit drinks, and milk and milk products listed in Part XVI of Annex I of the Regulation (EU) N°1308/2013, establishing a common organisation of the markets in agricultural products. Finally, it also establishes exemptions from the obligation to meet the reuse and refill targets (e.g. if the sales area is less than 100 m2, including storage and dispatch areas).

These measures are issued from the draft of November 2022 and the debates with different stakeholders are not closed, so the targets can still be modified… Before the plenary vote in October 2023, the Parliament's environment committee is expected to vote on the draft law in September.

5.2. Regulation N°1935/2004

The Framework Regulation N°1935/2004 is being reviewed by the European Commission, in order to reduce the presence and the use of hazardous chemical substances, to consider the latest technological and scientific progress and to promote safe reusable and recyclable solutions. This initiative[70] aims to identify and prioritize the risk assessment of substances, especially NIAS and potential cocktail effects, and to take into account the latest scientific and technological advances.
This revision follows a public consultation led by EFSA in collaboration with ECHA from October 2022 to January 2023. Considering the extent of the scope of this regulation and required modifications (all food-contact materials, incorporation of the concept of circular economy, policy themes to be detailed, etc.), other public consultations should follow and the revision is not be expected to be approved before the end of 2024.

5.3. Regulation (EU) N°10/2011

On January 2023, the European Union announced its intention to revise the Regulation N°10/2011 on food contact plastics, with several purposes such as modifying SML, setting incorporation limits of production scrap into a material, adapting rules on migration tests for multi-material multilayers, adding rules for the quality control and the production scrap management, etc.
A draft Regulation[71] and its Annex[72] were published and propose that some substances of the positive list, especially phthalates, are concerned by new restrictions of use and lower SML. Phthalates, considered as endocrine disruptors and most of which are classified as "reproductive toxins", are used in the polymerisation of PVC, which is mainly used in non-food applications but can be found in flows of polyolefines (PE, PP) or PET due to their visual similarity with PVC, or to unintended pollution. They can also be used as catalysts in the polymerization of PP or PET, in very low quantities compared to the limits.
The approbation of the new regulation is expected in July.

5.4. REACH regulation (Registration, Evaluation, Authorisation and restriction of CHemicals)

The European Commission works to review regulation regarding chemical substances as part of the Green Deal roadmap. Consequently, it has published its Chemicals strategy for sustainability (COM(2020) 667 final)[73] on 14 October 2020 that is a part of the European zero pollution ambition.

This European Chemical strategy has two objectives: a better protection of citizens and environment, and developing innovation for safe and sustainable chemicals. To carry out them, the "Chemical strategy for sustainability" integrates 80 actions in different domains, such as:

- Banning the most harmful chemicals in consumer products - allowing their use only where essential;
- Account for the cocktail effect of chemicals when assessing risks from chemicals;
- Phasing out the use of per- and polyfluoroalkyl substances (PFAS) in the EU, unless their use is essential;
- Boosting the investment and innovative capacity for production and use of chemicals that are safe and sustainable by design (SSbD), and throughout their life cycle.

The strategy promotes the transition to "SSbD chemicals and materials", whose some actions have implications for the plastic packaging. As a first step, the Commission is developing a framework setting out the steps and criteria for assessing their safety and sustainability. It will aim to provide with specific guidance for how to assess "safety and sustainability in a combined approach, starting at the design phase of new chemicals and materials but also at later stages of their lifecycle". In sum, the aim is to integrate safety, circularity and functionality of products (whose packaging) and processes throughout their lifecycle, from design to end of life also considering the possibility to recycle, reuse or repurpose them.

Another important subject included in the Chemical strategy is to tackle the problem of the presence of chemical substances of concern in products and in their waste, this presence preventing their recycling. Thus, several actions to minimize and substitute substances of concern are foreseen:

- Ensuring that the most harmful substances in products are phased out;
- Introducing minimum requirements to minimize substances of concern in products;
- Supporting investments to decontaminate waste streams and to increase safe recycling.

As part of this regulation review, a Commission Staff Working Document namely "Restrictions roadmap under the chemicals Strategy for Sustainability"[74] was published on 25 April 2022. The revision of this regulation is crucial because it proposes an approach to the assessment of chemical products no longer substance by substance but by family of products. It would lead to a simplified procedure, as in the case of perfluorinated compounds, a large family of more than 4000 compounds, or the identification of endocrine disruptors (the data necessary for this identification are not currently requested). Last but not least, the Commission work plan includes also the revision of sectoral product legislation, including FCM.

On 18 October 2022, the European Commission announced a delay in its work program and the postponement of the publication of the REACH revision proposal to the fourth quarter of 2023.
Given the European elections to be held in May 2024, it is likely that the revision of the REACH Regulation will not, in the end, be published before this date.

5.5. British regulation

As explained in Section 4.2.6, the four nations of the UK are currently debating the introduction of several measures to regulate the production of plastic items and the management of waste. Indeed, the UK transposed the European SUP Directive for England and Wales, which entered into force on 1 October 2020, a few weeks

before the end of the transition period (31 December 2020). For this reason, it is not effective. After this period of uncertainty and from 1 January 2022, diverse ranges of single-use items have been banned in Northern Ireland, Scotland and Wales. The UK Government rejected the laws resulting from these regional initiatives but confirmed in January 2023 that it is set to ban single-use plastic items relating to takeaway food and drink, with a legislation expected in October 2023 and applicable throughout the whole territory.

In addition, **The Environnement Act 2021 Bill** (2021 c.30)[75] of the Parliament of the UK is a part of the new legal framework for environmental protection set up after its exit from the EU and the end of the transition period. It is an important piece of legislation for plastics and packaging because it aims to improve air and water quality, protect wildlife, increase recycling and reduce plastic waste. It does not include specific measures to the reuse of packaging, but it has to establish EPR schemes and DRS, and implement new charges for single-use plastics. It confers powers on the national authorities of England, Wales and Northern Ireland to allow deposit return schemes to be established and enforced from 2023. A key focus for the UK Government is then to implement a scheme, which ensures regulatory consistency across the UK, bearing in mind that the Scottish Government has created the legal framework for a DRS for drinks containers made from PET plastic, glass, steel, or aluminium. The Scottish Parliament approved the Regulations on 29 April 2020 and the scheme had to go live in July 2022, but it has been postponed.

6. Regulatory summary for each BUDDIE-PACK use case

The purpose of this chapter is to summarise regulations and standards that cover each use case. It shall allow to find all information sources at a glance, to better inform these aspects and to incorporate them into the packaging design. This anticipation of constraints shall enable to develop and to produce packaging fully adapted to the needs.

For better readability, use cases of AUSOLAN, VYTAL and UZAJE have been gathered because they concern food products and are subject to European regulations.

The use case of DAWN MEATS is separated from the others because it is operated in the United-Kingdom, so it is subject to UK regulations.

The use case of ASEVI is also separated from the others because it concerns non-food products, so regulations and standards which have been detailed previously do not all apply.

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	Main constraints	Location of use	REGULATIONS COVERING THE USE CASE				STANDARDS COVERING THE USE CASE	
			European hygiene regulations	European packaging regulations	National regulations	Regulatory revisions in progress to consider	Hygiene standards	Packaging standards
AUSOLAN Use case: Catering trays use case implementation at schools and nursing homes	Clip-on lids or heat sealing, and GA50 watertight for soups and creams, rice/pasta, veggies, salads, roasted meat, fish, desserts	Ausolan, Spain	**Hygiene Package**: - Regulation N°178/2002, laying down the general principles and requirements of food law - Regulation N°852/2004, laying down the general rules for food business operators on the hygiene of foodstuffs - Regulation N°853/2004, laying down specific hygiene rules for food of animal origin - Regulation N°2017/6252, laying down rules for the performance of official controls and other official activities by the competent authorities of the Member States **Washing**: - Directive 98/83/EC, on the quality of water intended for human consumption - Regulation N°648/2004, on detergents - Regulation (EU) N°528/2012, concerning the making available on the market and use of biocidal products **Other**: - Regulation N°2073/2005, on microbiological criteria for foodstuffs - Regulation N°931/2011, on the traceability requirements for food of animal origin	**Design**: - Directive 94/62/EC and its amendment Directive (EU) 2018/852, on packaging and packaging waste - Directive (EU) 2019/904 (SUP Directive), on the reduction of the impact of certain plastic products on the environment **Food contact**: - Regulation (EC) N°1935/2004, on materials and articles intended to come into contact with food - Regulation (EU) N°10/2011 and its amendment Regulation (EU) 2020/1245, on plastic materials and articles intended to come into contact with food - Regulation N°1907/2006 (REACH), concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals **Production**: - Regulation (EC) N°2023/2006, on good manufacturing practice for materials and articles intended to come into contact with food - Regulation (EU) 2022/1616, on recycled plastic materials and articles intended to come into contact with foods	**Spain (complementary regulation to European ones)**: Royal Decree 1055/2022 on packaging and packaging waste	**Design**: - Directive 94/62/EC on packaging and packaging waste **Food contact**: - Regulation (EC) N°1935/2004, on materials and articles intended to come into contact with food - Regulation (EU) N°10/2011 and its amendment Regulation (EU) 2020/1245, on plastic materials and articles intended to come into contact with food **Safety**: - Regulation N°1907/2006 (REACH), concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals	**Safety of food products**: The international food safety management system ISO 22000 harmonizes the existing standards by incorporating the principles of the HACCP system **Manufacture and supply of food packaging**: The European hygiene management system EN 15593:2008 specifies the requirements applicable to the industrial actors concerned **Washing hygiene in a professionnal environment**: The European standard EN 17735:2022 specifies the hygiene requirements for the operation of commercial dishwashing machines, and tests to be carried out on these machines	**Design of reusable items**: - The European standard EN 12875-1:2005 (part 1) defines a test method for determining the mechanical strength in the dishwasher of articles for household use. - The Spanish standard UNE-53928:2023 specifies a test method to verify that plastic tableware manufactured by thermoforming or injection moulding process can be used at least 5 times after each dishwashing process.
VYTAL Use case: Catering trays for take-away food	Three compartments bowls with clip-on lids, same type of products as Use case of Ausolan	Vytal, Germany and France			**Complementary regulations to European ones** **Germany**: Packaging Act VerpackG **France**: Anti-Waste Law for a Circular Economy n°2020-105			
UZAJE Use case: Catering packaging for on-the-spot food consumption in supermarkets	Thermosealed plastic film on trays for food sales in supermarkets, same type of products as Use case of Ausolan	Super-markets, France			**France (complementary regulations to European ones)**: Anti-Waste Law for a Circular Economy n°2020-105			

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	Main constraints	Location of use	REGULATIONS COVERING THE USE CASE			STANDARDS COVERING THE USE CASE	
			Hygiene regulations enforced in UK	Packaging regulations enforced in UK	Regulatory revisions in progress to consider	Hygiene standards	Packaging standards
DAWN MEATS **Use case**: Meat secondary food packaging use case implementation	Skin packaging	Dawn Meats, United Kingdom (country of operations)	**Hygiene**: - The General Food Hygiene (Amendment etc.) (EU Exit) Regulations 2019 - The Specific Food Hygiene (Amendment etc.) (EU Exit) Regulations 2019 - The Official Controls (Animals, Feed and Food, Plant Health etc.) (Amendment) (EU Exit) Regulations 2020 - The Food and Feed Hygiene and Safety (Miscellaneous Amendments etc.) (EU Exit) Regulations 2020 **Washing**: - The Water Supply (Water Quality) Regulations - The Floods and Water (Amendment etc.) (EU Exit) Regulations 2019 - The Detergents (Amendment) (EU Exit) Regulations 2020 - The Biocidal Products (Health and Safety) (Amendment) Regulations 2022	**Design**: - The Environmental Protection Act 1990 - The Producer Responsibility Obligations (Packaging Waste) Regulations 2007 - The Packaging (Essential Requirements) Regulations 2015 - The Plastic Packaging Tax (General) Regulations 2022 **Food contact**: - Regulation (EC) N°1935/2004, on materials and articles intended to come into contact with food - Regulation (EU) N°10/2011 and its amendment Regulation (EU) 2020/1245, on plastic materials and articles intended to come into contact with food - The REACH etc. (Amendment etc.) (EU Exit) Regulations 2020 **Production**: - Regulation (EC) N°2023/2006, on good manufacturing practice for materials and articles intended to come into contact with food - Regulation (EC) N°282/2008, on recycled plastic materials and articles intended to come into contact with foods	**Design**: - Regulation on the reduction of the impact of certain plastic products on the environment (equivalent to the European SUP Directive) **Depending on the british regulatory policy and European revisions in progress (sum up in previous page), modifications may be expected on the equivalent regulations in the United-Kingdom**	**Safety of food products**: The international food safety management system ISO 22000 harmonizes the existing standards by incorporating the principles of the HACCP system **Manufacture and supply of food packaging**: The European hygiene management system EN 15593:2008 specifies the requirements applicable to the industrial actors concerned **Washing hygiene in a professionnal environment**: The European standard EN 17735:2022 specifies the hygiene requirements for the operation of commercial dishwashing machines, and tests to be carried out on these machines	**Design of reusable items**: - The European standard EN 12875-1:2005 (part 1) defines a test method for determining the mechanical strength in the dishwasher of articles for household use. - The Spanish standard UNE-53928:2023 specifies a test method to verify that plastic tableware manufactured by thermoforming or injection moulding process can be used at least 5 times after each dishwashing process.

Main constraints	Location of use	REGULATIONS COVERING THE USE CASE				STANDARDS COVERING THE USE CASE	
		European hygiene regulations	European packaging regulations	National regulations	Regulatory revisions in progress to consider	Hygiene standards	Packaging standards
Home care products presented to customers in bag in box packaging solutions, and potentially empties rigid packaging collected before cleaning	Spain and France	**Washing**: - Directive 98/83/EC, on the quality of water intended for human consumption - Regulation N°648/2004, on detergents - Regulation (EU) N°528/2012, concerning the making available on the market and use of biocidal products	**Design**: - Directive 94/62/EC and its amendment Directive (EU) 2018/852, on packaging and packaging waste - Directive (EU) 2019/904 (SUP Directive), on the reduction of the impact of certain plastic products on the environment **Safety**: - Regulation N°1907/2006 (REACH Regulation), concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals - Regulation (EC) N°1223/2009, on cosmetic products	**Complementary regulations to European ones** **Spain:** Royal Decree 1055/2022 on packaging and packaging waste **France:** Law Climate and Resilience n°2021-1104	**Design**: - Directive 94/62/EC on packaging and packaging waste **Safety**: - REACH Regulation N°1907/2006, concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals	No standard has been identified on this matter	**Design of reusable items**: - The European standard EN 12875-1:2005 (part 1) defines a test method for determining the mechanical strength in the dishwasher of articles for household use. - The Spanish standard UNE-53928:2023 specifies a test method to verify that plastic tableware manufactured by thermoforming or injection moulding process can be used at least 5 times after each dishwashing process.

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	ASEVI Use case: Packaging for home care loose goods in supermarkets

7. Barriers and opportunities for the implementation of the reuse of packaging

This general state of the art and the regulatory outlook related to ongoing revisions that we have detailed in previous chapters allows us to identify several barriers and opportunities for the implementation of the reuse of packaging:

- Regulatory
- Technical
- Safety
- Social
- Economic

Considering numerous technical factors and views about environmental barriers and opportunities, and given that the WP7 is dedicated to this issue, this section will not deal with these aspects.

7.1. Regulatory

Regulatory barriers

Hygiene regulations establish an obligation of results towards the actors of the value chain (e.g. a concentration of bacteries less than a value set by the regulation), and not of means (e.g. no obligation of ventilation, regulated temperature or any other mean of achieving compliant hygiene). Thus, the reuse of packaging does not conflict with hygiene constraints on condition that each part provides the required health guarantees on its scope. However, as it is still a new subject for industry, an uncertainty remains to be able to achieve obligation of results, despite the safety measures to limit risks. Our innovation approach and the proof of concept should allow to identify risky points in advance and to develop solutions to scale up without risk.

The ongoing revision of the REACH regulation imposes important material selection inputs for the design of innovative solutions. It concerns a priori plastic materials but also detergents, surfactants or biocides used in the washing process. Given the many substances contained in plastics and the challenge of making them less sensitive to ageing, we can assume a wider complexity on this matter than on cleaning products. This has to be considered into the SSbD concept, which is explained in Section 5.3.

In the regulation N°10/2011, the specific migration test method for reusable materials includes a limit. As the material is tested on a low number of reuses, it is supposed to keep the same quality throughout the test, without any damage such as scratches, although it can expose the material to a higher risk of migration. In real conditions of the reuse of packaging, this risk assessment will therefore be incomplete, since it does not include the use of cutlery, for example. To ensure that Regulation N°10/2011 is respected throughout the lifetime of reusable packaging on SML, a migration of the total content should be considered taking into account the contact surface with food, in order to guarantee that the content of each substance likely to be released is below its SML.

As it is written in the chapter on hygiene standards, the EN 13697 standard allows to check efficiency of biocides on steel carrier, mainly present in school or collective catering, restaurants, etc. However, such a standard does not yet exist for plastic materials, suitable for the food industry, although it would be a useful control tool for it.

Opportunity N°1: Current regulation discussions and perspectives of evolution

The action levers may be strengthened on the regulatory level within the next 18 months, depending on directions that will be taken by the Packaging & Packaging Waste Regulation in the EU by the end of 2023 and the Global Plastic Pollution Treaty by the end of 2024.

Regardless of the outcome of negotiations and the concrete measures which will be decided, these debates contribute to bringing the issue of plastic waste to the different sectors of society (citizens, businesses, municipalities, etc.) and to giving them a global trajectory and tools to cooperate in the implementation of solutions.

7.2. Technical

Technical barriers

A major technical obstacle is the lack of knowledge about the ageing of plastics through cycles of use and washing. BUDDIE-PACK is one of the first consortia to assess and to measure the evolution of plastics' properties in reuse applications, on mechanical, functional and aesthetic aspects of each repeated step of the reuse cycle:

- Food packaging procedures including e.g. thermal treatments possibly leading to the degradation of polymer chains, or repeated sealing possibly causing tightness issues and in turn, limited food preservation with potential health issues for the consumers;
- Transportation possibly causing mechanical stresses leading to surface abrasion, deformations;
- Usage by the consumers with potential damages caused by cutlery (e.g. scratches, abrasion);
- Washing protocols involving contacts with hot water up to 85°C, water abrasion, contacts with cleaning agents.

Last but not least, food quality is strongly correlated with the quality of the packaging. Additionally to a possible coloration of the packaging after repeated contacts with a variety of food or cleaning agents, a modification of the organoleptic properties of the packaging is also likely. This would cause a degradation of the food properties (e.g. transfer of smells), which would not be acceptable for the consumers. A more subtle verification of the safety of packaging must even be carried out with regard to the migration between the packaging and the food of chemical substances originating from e.g. cleaning agents, but also of allergens with a potentially significant risk for consumers. The development of technical tools to measure the potential presence of detergents or allergens in packaging is a sensitive point, and will probably lead to revise working methods.

Another main barrier is logistics: the management of the logistic flows and storage of packaging can scare the packaging's users, which do not have always suitable premises, staff or organisation. Experimentation is essential to spot pain points along the reuse value chain:

- Collection of used packaging: mode of collection, free deposit by the consumer or managed by the user, set of reverse vending machines;
- Storage of packaging: calibration of the required area for dirty and clean ones, organisation of flows between separate zones (dirty/clean) and with the production zone, storage time before cleaning and efficiency of the devices in place to avoid pest access and harbourage;
- Organisation of transport: mode of transport (the reverse logistic, which consists of loading dirty packaging at the same time as the delivery of clean ones, is especially recommended to reduce transport), frequency depending on the business activity and the available storage area.

Opportunity N°2: Traceability of containers

Given the PPWR proposal which stipulates that any packaging shall bear a Digital Product Passport, it means that information on its reusability shall be provided by a QR code or any other type of digital data carrier: collection points, tracking of the packaging, calculation of trips and rotations, etc., and why not its conditions of use. Provided that the technical issues of its implementation are solved, this passport could therefore be an effective

lever for optimising the return of packaging and its durability. The type of constraints of the user (technical, logistic, economic) and information to be marked should guide the choice of technical solution, as some of these markings are washable and others are permanent: inkjet, labeling, laser engraving, RFID tag... They can also have an incidence on the packaging recyclability.

Opportunity N°3: Standardisation of packaging

To facilitate the logistic level, an essential factor will be the standardisation of packaging on a large scale, which will allow an optimisation of transport and storage. This work has to be driven and coordinated at a European level, in cooperation with EPRs and business operators (industries, retailers, etc.). It should be noted that it will lead manufacturers and retailers to reinvent their brand marketing, to develop new strategies to differentiate their products in stores and to communicate on them. It means that these strategies will have to rely on elements other than those usual:

- The brands will have to develop other levers of differentiation than the shape of the packaging (label, cap, in-store display, etc.), so that the consumer can spot the product he is looking for.
- The development of e-commerce has been shaking up consumers habits in recent years: beyond these physical aspects visible in stores, digital marketing is also a powerful lever to inform consumers on products, in such a way that they choose them sometimes before they see or touch them (online products catalog, online order, drive shopping, etc.). In this context, the specificity of packaging could become useless for certain products and the standardisation would no longer necessarily be an obstacle.

A coordination of EPRs on a European scale would even be desired so that any European reusable packaging could find its way into a reuse system, regardless of the European country where it is located at a given time.

Opportunity N°4: Capitalisation on logistic experience

Manufacturing and retailing sectors already have experience with reusable packaging, either commercial ones such as glass bottles (beers, soft drinks…) or industrial ones (pallets, transport crates…), which can be very useful and decisive in our progress in the project. It should be instructive to know in detail how the reuse of these packaging works, in BtoB and in BtoC schemes, to deepen our understanding of logistical parameters. To this date, there are quite few cases of reuse of plastic packaging by the food industry in an open loop (i.e. with the consumer intervention), so it will be useful to capitalise on this experience, more for logistic level than for the ageing of plastic in various conditions (heating, food contact, etc.).

7.3. Safety

Safety barriers

Solving safety obstacles is decisive to develop the reuse of packaging. They cover three categories of aspects, related to the nature of plastics:

1) Even if there are significant differences between polymer resins, plastic materials do not absorb heat and have an intrinsic capacity to absorb or release many types of chemical substances. In the case of water, it makes the plastic difficult to dry, favours microbiological non-compliance and could lead to the presence of mould if it is stored for a long time, which is irreversible to its integrity. It suppose that a hand pre-wash before sending dirty containers for cleaning can increase safety risks. Other substances may be absorbed, like food residues, so allergens, detergents, etc., and may then be released during the following use. This issue is all the more sensitive in an open loop: in this case, rules should be specific and can not be the same as in a closed loop, where the safety is managed by industrial users according to quality procedures, which limits the risk of misuse. These stakes should lead the consortium to define microbiological and chemical targets for the rinsing and the drying;

2) At this date, there is a lack of knowledge on risks of migrations of substances contained in plastics from their manufacturing, in specific configurations unknown to the food industry: migrations that may occur from plastics which have scratches, presence of neo-formed compounds after potential physico-chemical interactions

between plastic material and detergents (the risk is minor due to the short time contact and the rinsing step, but it has to be studied before being ruled out)…

3) Another unknown subject is the deterioration of the material in microplastics. Plastic materials are sensitive to repeated friction: however, there is very few practical experience in specific configurations such as friction by cutlery, by pressure washing, due to stacking of packaging during transport, etc.

Opportunity N°5: Industrial means

The business operators are able to ensure the safety related to the reuse of packaging (ventilation, ambient temperature and/or humidity control, odour control, ease to clean premises and equipments, etc.), provided to set up adequate facilities and to train a specific staff to implement and apply control procedures. These means allow to prevent contamination of foods and/or refill stations by micro-organisms, chemicals and allergens (measurements, management of flows and storage of dirty packaging, etc.).

Opportunity N°6: Capitalisation on experience in food safety

Some sectors having experience with the reuse of primary packaging, it would be instructive to capitalise on it to build our mastery of safety parameters: bottlers, school catering, food shops such as bakeries, etc.

7.4. Social

Social barriers

Social barriers are difficult to solve because they require changing deep-rooted habits, for both packaging's users and consumers.

As reusable packaging is heavier and sturdier than single-use ones, users may be afraid of wasting time in their daily tasks (additional time to handle, store, wash, wipe, etc.). Some of consumers could be reluctant to use a packaging that they gauge it has already been used (scratch, small stain, discoloration, etc.), even if it is clean and safe, because we often implicitly associate "new", "clean" and "efficient", or "used", "dirty" and "dysfunctional". In Germany where the reuse of packaging is well established, a glass bottle with scratches is perceived as a sign of quality because it means that it has been used multiple times and it is solid! Even if the material is different in this case, it means that there are therefore differences in perceptions of the reuse of packaging and it would be interesting to reflect on the levers of influence.

Then, the loop only works with the participation of the consumer: the reuse of packaging requires that he anticipates the organisation of his shopping and that he transports the empty packaging to bring it back to the point of sale. Before this change becomes a habit, it may seem complicated and likened to a waste of time.

Opportunity N°7: Active consumerism

Active consumerism can effectively contribute to the proper functioning of the reuse of packaging: giving the consumer responsibility for returning the used packaging is giving them the opportunity to play an active role in the reduction of waste, rather than being a passive consumer, which is very rewarding. Besides, several countries in the UE deployed deposit return schemes for recycling PET bottles or aluminium cans, which enabled to increase, or even reach their recycling targets. It shows that the consumers' involvement can be decisive, thanks to implementation of adequate public policies.

Opportunity N°8: Packaging value

Since reusable packaging is heavier and stronger compared to most single-use packaging, it should be perceived as a real object of everyday life, and not as waste that can easily be abandoned as soon as we don't need it anymore. As it cannot fly through the air, unintended leaks in the streets or into the nature should also be reduced (dumps, pierced bags by cats or birds, etc.). On a large scale, it enables to reduce significantly and visibly the amount of trashes in streets and waste on the ground.

7.5. Economic

Economic barriers

The reuse of packaging involves steps of washing, transport, storage, etc. and an adequate workforce, which are quite new for the packaging's user. Reusable packaging is heavier, stronger and more expensive, and can require an important upfront investment for them. Therefore, this system will be profitable after new economic models have been developed, implemented and gradually improved. Even if their exact role is not yet defined, business operators will have to be strongly involved in the management of the loop in opposition to the management of waste, which is dealt by local authorities.

Required investments can be an obstacle for users, especially for SME and if they are afraid of thefts, as it happened in France when the AGEC law entered in force in January 2023 in fast-foods. However, we can assume that it is linked to a fashion effect, which is going to fade quickly and which can be avoided by the standardisation. To date, traditional deposit schemes are based on systems where consumers pay when the packed food is purchased. There is here a twofold obstacle for the acceptance of the reusable packaging:

- The consumer must bring the packaging back to the point of sale to be reimbursed; it can be perceived as a waste of time by the consumer;
- The price of the food packed in a reusable packaging is perceived as higher than its counterpart packed in a single-use packaging.

Opportunity N°9: Variety of deposit return schemes

To free consumers from high deposit schemes, also other mechanisms such as library models can be applied. In this case, consumers only pay a penalty if the packaging is not returned in a certain amount of time or is heavily damaged. Reflection on new economic models should make it possible to develop new incentives, adapted to the different types of economic activity.

Opportunity N°10: Eco-modulation

Investments by users in their packaging pool should be partly offset by the reduction in collective waste management taxes and EPR fees.

Opportunity N°11: Shared logistics

Given that infrastructure is needed to support reusable packaging and that their development would be costly for individual companies, they should therefore be used in the pooling system which allows to share infrastructure such as transportation and washing facilities.

Opportunity N°12: Independence from energy cost instability

Finally, in the context of the energy crisis since 2022, which remains quite uncertain, the reuse of packaging can allow to keep the pool in an area relatively close to the points of consumption, provided that there are enough washing centers for mesh the territory. It should make users less dependent on variations in energy costs, in particular the gasoline needed for transport, which may continue to impact the costs of single-use packaging.

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8. Conclusion

This deliverable provides regulatory and standard resources, highlights the conflicts between the reuse of packaging and hygiene constraints, and proposes an analysis of the main barriers and opportunities of this goal: it should allow business operators to investigate critical points, depending on their specificities, and to implement the reuse of packaging in safe conditions. The BUDDIE-PACK use cases will lead to studying these specificities (type of product, location of use, modalities of use, etc.).

Some loopholes or grey zones in the hygiene regulations and standards are raised about the issue of reusable packaging (non-food products, qualification parameters of water intended for human consumption, assessment of the effectiveness of biocides on plastic surfaces, migrations of substances from reusable packaging…): indeed, most of these texts were written before reusable packaging appeared as a future solution to solve the waste problem.

Regulatory news have been very dynamic in recent months and several progress are expected by the end of 2023 (PPWR, United Nations treaty, transposition of the European SUP Directive into the British regulation), so it must be recalled that this report is a picture at this day. At the same time, the application of laws that several countries have set to develop the reuse of packaging continues, which keeps the matter on the front of stage and contributes to make citizens aware of the need to change their uses.

Whereas major barriers to the development of reusable packaging are detailed (regulatory, technical, safety, social, economic), the report also highlights the action levers which must be engaged or are within reach to control the quality and safety of products marketed in reusable packaging:

- Opportunity N°1: Current regulation discussions and perspectives of evolution
- Opportunity N°2: Traceability of containers
- Opportunity N°3: Standardisation of packaging
- Opportunity N°4: Capitalisation on logistic experience
- Opportunity N°5: Industrial means
- Opportunity N°6: Capitalisation on experience in food safety
- Opportunity N°7: Active consumerism
- Opportunity N°8: Packaging value
- Opportunity N°9: Variety of deposit return schemes
- Opportunity N°10: Eco-modulation
- Opportunity N°11: Shared logistics
- Opportunity N°12: Independence from energy cost instability

Finally, this document should also be used as a tool in several WP for BUDDIE-PACK:

- In the WP1, the tasks of specifying reusable plastic packaging and developing design rules for the 5 usecases' packaging should be checked to be complete and in accordance with this state of the art;
- In the WP5, the risk assessment on the quality and safety of reusable packaging after use should be correlated with the revised regulations N°1935/2004, N°10/2011 and REACH. The aim is to remove all safety barriers, such as microbiological and chemical safety, as well as assessment of post-use functional properties and microplastics release;
- In the WP6, each step of the large scale demonstration should be ensured to comply with this state of the art and to take place without risk, after having solved all critical points identified by the operators and the barriers mentioned in this deliverable.

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